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CHARLES K. HAMILTON IN HIS BIPLANE RACING WITH AN AUTOMOBILE ON THE BEACH AT GALVESTON, TEXAS.—[See page 211.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The "Human Interest" at Panama

IN the course of a recent interview Col. Goethals stated to the Editor of this journal that, if he were asked to indicate the secret of the success with which the Panama Canal is being built, he would unhesitatingly name the human interest. "By 'human interest,'" said Col. Goethals, "I mean the pride which every one feels in the work as a whole and particularly in that part of it for which he is personally responsible."

Now there is nothing in this to contradict the general impression that the great accomplishments at Panama are due to the fine organization under which the work is being done. In an engineering task of this stupendous magnitude, zeal without organization would be fruitless. But given a single head, with practically absolute authority; a carefully planned organization; and a zealous ambition on the part of the staff to secure the greatest possible results; and you have a Panama Canal, ready for traffic a year or more ahead of the date originally set for its completion.

When Col. Goethals spoke smilingly of his control of the work as being "a sort of benevolent despotism," the phrase was luminous and altogether appropriate. One of the wisest acts of Congress was its vesting in one man the whole responsibility for the successful carrying through of the scheme for a high-level lock canal. It is to this policy of "let alone" that much of the phenomenal success is due. In effect, the United States government said: "Here are the plans, the working force, and the necessary funds; build, as cheaply and as speedily as possible, a canal whose permanence shall be beyond all shadow of a doubt."

Now the attitude of Congress to its chief executive at the canal is exactly the attitude of the chief to every subordinate who is working under the controlling hand—gentle, sympathetic, elastic, but strong—of his "benevolent despotism." To every subordinate—be he a colonel in charge of the great locks and dams, or foreman of a construction gang—is allotted a certain section of the work, for which he is absolutely responsible, and in the execution of which he is given an opportunity to display such gifts of initiative, organization, and mastery of detail, as he may naturally possess.

Give a man his general instructions, leave him a free hand in carrying them out, emphasize his sense of responsibility, and you appeal to his proper and natural pride of position. In such an atmosphere, the microbes of listlessness, perfunctory performance of duty and "loafing," die out as surely as disease germs in pure mountain air or in the cold of an Arctic journey. In such an atmosphere, moreover, there readily develops that other master motive of successful work—the spirit of competition. We recently had occasion to show, in these pages, what great results have been achieved in our navy by appealing to the competitive instinct. The enthusiasm with which officers and seamen are straining every nerve to become the finest marksmen afloat finds its counterpart in the ardor with which, under army control, engineers and men are putting through the world's greatest physical undertaking, on a scale of economy and all-round efficiency that has never been surpassed.

Merchant Marine a National Issue

IF the interest in a subject is to be judged by the correspondence which reaches the Editor's desk, the present deplorable condition of our Merchant Marine must rank high in importance among the readers of the SCIENTIFIC AMERICAN. Many of these letters we have published, notably those which have contributed some new point of view of this complicated national question.

Those of us who have the welfare of the Merchant Marine at heart are gratified that the opportunity presented by the Panama Canal for stimulating the construction and operation of American ships, is being seized and turned to what good account it may. But we must not forget that the stimulus thus afforded is, after all, merely local and limited. The Merchant Marine question is broader than any canal—it covers the seven seas and reaches to every port in which the American flag is conspicuous by its absence—and that means practically every foreign port in the world!

In view of the many evidences that the average citizen of the United States is anxious to see American shipping restored to its one-time proud position, the apathy of Congress is, to say the least, bewildering. The motives which should prompt immediate action are not wanting, surely, in power of appeal. There is no surer sign of the masterful enterprise of a people than the visible token presented by that bit of bunting floating from the taffrail of a thousand ships, scattered over ten thousand leagues of the world's highway, or handling the nation's commerce in the myriad ports of the world.

And the purchase price of this exclusion of the American flag from the high seas is the three hundred millions of dollars which we pay every year to foreign ships for carrying that American freight which we refuse to handle ourselves.

The remedy is to be found in some form of Federal assistance. Any direct subsidy is distasteful to the American people; but we believe that an effective relief would be found in the system of preferential duties advocated by Congressman Sulzer in the bill now before Congress and described in our Merchant Marine issue of July 15th, 1911.

The Inventors' Guild

ANOTHER attempt is to be made to reform the American patent system, this time by an organization which calls itself "The Inventors' Guild" and which may really be considered representative, because its members include such distinguished engineers and inventors as Thomas A. Edison, Peter Cooper Hewitt, Prof. Michael I. Pupin, Dr. John F. Kelly, and Ralph D. Mershon.

Although the Guild has been in existence for two years, it has only recently given utterance to its views. That utterance (there is only one as yet) is neither a criticism of the Patent Office nor an attack on the courts, but simply a resolution addressed to the President of the United States, asking him to appoint a commission which is to investigate the system of granting patents and of conducting infringement suits in this country. When that commission has made its final report, the Guild believes that the inventors of the country, Congress, and the President will know more definitely just what steps are necessary to institute reforms. While patent lawyers and inventors are agreed that the system needs improvement, they do not concur in the manner of effecting the improvement.

Reforms are surely necessary. The Commissioner of Patents himself has time and time again explained to congressional committees the urgent needs of the Patent Office. He has pointed out that important public records are kept in storerooms that are really damp cellars; that a new building for the exclusive use of the Patent Office should be built in order that the whole procedure within the Patent Office may be improved; that action on important cases is needlessly delayed; that the system of making searches should be bettered; that the method of conducting interference proceedings renders it impossible to consider cases exhaustively; that, in a word, the Patent Office should be allowed to spend the millions of dollars which it has turned into the United States Treasury in order to give better service to inventors. Repeated appeals by the present commissioner have brought some slight relief in passing years, too slight, however, to be of very much effect.

Our patent court procedure, too, has been made the subject of rather heated comment before congressional committees. If anything, the hearing of a patent infringement case is even more protracted than the trial of a criminal. The great manufacturing firms of the country have spoken bitterly of the delays that are incurred before infringers are eventually restrained. Mr. Frank L. Dyer, who is Mr. Thomas A. Edison's counsel in patent matters, has made the statement that the prosecution of infringers of Mr. Edison's electric lamp patent involved an outlay of about one million dollars, and that even after this huge sum was expended, Mr. Edison did not succeed in getting an accounting of all the profits to which he was entitled. The Selden patent, with its score of volumes of printed testimony, is a brilliant example of the absurd lengths to which we go in needlessly complicating infringement suits. The old protracted Chancery cases, of which Dickens has written so bitingly, find their counterpart in many a patent cause tried in this country. Readers of the SCIENTIFIC AMERICAN are familiar with the Knibbs patent valve case, which dragged along wearily for thirty years. Many months have now elapsed since the Wright Brothers began their action for alleged infringement of their patents. How many years must pass before the case is finally decided on appeal?

Patent attorneys, who are supposed to live on cases long drawn out, have been among the first to urge reforms. Readers of the SCIENTIFIC AMERICAN will recall that we have commented on more than one bill introduced in Congress for the purpose of creating a Court of Patent Appeals, a court which would be composed of men who are both lawyers and technologists; a court, in other words, capable of deciding both technical and legal questions. It is the opinion of many engineers and patent lawyers that too much is asked of an ordinary judge. He is a trained lawyer, not a trained metallurgist, chemist, or mechanical engineer.

It is easy enough to rail at the patent system and to claim that neither the inventor nor the manufacturer is treated with justice. It is easy enough to place one's finger upon this or that evil and to ask for its correction. What is wanted is a complete picture of the patent system, a clear conception of where it falls short of the inventor's demands. In asking for a commission which will paint such a picture the Inventors' Guild has acted wisely. Not until the facts are ascertained should correction be recommended.

Because the prosperity of this country may be directly traced to the patent system, reforms should be made only after long deliberation. Judged by results, our patent system must surely be commendable in most respects. It must not be forgotten that the amount of capital invested in agricultural implements, many of them patented, amounts to about $200,000,000; that nearly $29,000,000 is invested in patented sewing machines; that over $175,000,000 is invested in electrical establishments where patented dynamos, motors and electrical machinery are produced; that over $11,000,000 worth of patented typewriters are sold every year. Indeed, almost every object which we habitually use or which contributes to our comfort in some way, is either patented or made by patented machinery. Surely there must be some merit in a system which has stimulated thousands of inventors and which has made the energy and the enterprise of the American inventor proverbial throughout the world. Upon a commission of men, of the type that the President knows so well how to select, the virtues of a system which has produced so remarkable a result will surely not be lost. Should the President give heed to the Guild's appeal, the result can only be an authoritative diagnosis of our patent ills. When that diagnosis is before us, the cure will be apparent.

The investigation which has been planned by the Inventors' Guild may be compared with the work that the President hoped to accomplish with the Tariff Board. In other words, the facts are to be ascertained before legislation is enacted.

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Engineering

Panama Canal Work in January.—The total of canal excavation to February 1st was 160,591,180 cubic yards, leaving 34,732,199 cubic yards to be completed. This shows that about one-fifth of the entire work of excavation yet remains to be done. On the same date 78 per cent of the concrete work on the locks was in place, Gatun locks being 90 per cent completed, the Pedro Miguel lock over 96 per cent, and the twin locks at Miraflores over 48 per cent completed.

Montauk Harbor Again.—The announcement of certain real estate transactions has once more started a series of newspaper articles tending to show the great future of Montauk as a terminal for the transatlantic steamers. It is easy to figure out a saving of a few hours on a transatlantic trip; but we firmly believe that even if such a port were established, the bulk of the passengers would prefer to finish their journey to New York in a palatial steamer rather than in the relatively crowded cars of a steam railroad.

Conservation by Drainage.—In view of the great success of conservation by irrigation the movement for conservation by drainage of swamp and overflow lands should receive national attention and support. The National Drainage Congress has for its object the reclaiming of all lands now in a swampy condition. Gifford Pinchot of the National Irrigation Congress declares that there are 77,000,000 acres of swamp and overflow lands in the Mississippi Valley that can be made into farm land at a cost of $5 to $7 an acre. It costs from $20 to $40 to reclaim land by irrigation.

Record Track Laying.—It is to the American engineer and contractor that the world is indebted for its first lessons in rapid construction of railroads and particularly in rapid track laying. The lesson as taught on our western prairies has led to systematic methods of railroad construction, particularly with a view to time and labor saving, in other countries where extensive lines are being built. Thus, we notice that recently a record was made of 6 1/3 miles of main track and 1,200 feet of siding laid with rails in one day. The work was done under British engineers on the Baro Kana Railway in northern Nigeria.

Glass Makes Poor Paving Blocks.—Many of us will recall the interest which existed a few years ago in the subject of the use of glass for paving blocks, an interest which was out of all proportion to the importance of the subject. Our consul at Lyons reports that a glass maker of that city manufactured some glass blocks, which he was allowed to lay at his own expense on a thoroughfare where the city traffic is very heavy. The blocks lasted less than two years, many of them being split and all of them having their edges badly chipped. The results proved that glass blocks might be serviceable in sidewalks but never on a city thoroughfare.

Railroad Economy.—The efficiency and economy movement is showing itself at times in unexpected directions. Thus the *Rock Island Employees' Magazine* states that the Rock Island lines spend about $6,000 a year on the 325,000 pencils which they issue for the use of employees. It is believed that on an average, not more than one-half of the pencil is used before it is thrown away, and it is estimated that if each employee will use another inch or so of each pencil the saving will amount to about $2,000 per year. A suggestion, more practical than will be popular, has been made that each stub shall be returned before a new pencil is issued.

Admirable Revenue Cutter Service.—The personnel of the United States Revenue Cutter Service are to be congratulated on the excellent work which they have done during the past winter. Never a storm visits our coasts but the next day's papers have some record of timely assistance rendered, either in the way of saving passengers or towing disabled vessels to port. The service rendered is immensely varied, as note the work of the "Gresham" in keeping the ice floes at Nantucket sufficiently broken up to enable the island to get its supplies and mail service. But for the "Gresham" the islanders would have been entirely cut off during the recent cold spell.

Faulty Dams in New York State.—In a recent report, the Inspector of Dams and Locks of the State Conservation Committee gives facts regarding the present condition of many dams in New York State, which show how greatly these constructions stand in need of strict supervision. Two wooden dams must be entirely rebuilt and five others repaired. Several earth dams have no spillway; one reservoir was ordered emptied, and in eight others the water had to be lowered from four to ten feet to reduce pressure on the dam. The solid masonry dams showed many undesirable conditions; one reservoir was ordered emptied because of poor masonry, another on account of thin walls. The three reinforced concrete dams inspected were in fairly good condition.

Electricity

Electricity in Chicago.—The increasing demand for electricity in Chicago is well illustrated by a recent report on the output of the Commonwealth Edison Company. About ten years ago the record output of the company was 20,000 kilowatts; three years ago a record of 100,000 kilowatts was reached; this year, on the 4th of January, the record of 201,630 kilowatts was established.

Concrete Telegraph Poles in New Zealand.—Reinforced concrete telegraph poles are being used by the Postal Telegraph Department of New Zealand on the line between Auckland and Hamilton. Over 1,200 of the poles have been set up. They measure 26 feet high and taper from 6 by 8 inches at the base to 6 by 6 inches at the top. The poles are claimed to be only slightly heavier than the wooden poles they have replaced.

Device for Producing Artificial Respiration.—Two doctors in Chicago have recently devised an electrically-operated mechanism for producing artificial respiration during operations of lung surgery. Air is introduced into the lungs by a compressor through a valve operated by an electro-magnet. The valve is opened and closed periodically under control of a clock mechanism. This apparatus is reported to have sustained life in a dying patient for twenty-nine hours, while the surgeons were endeavoring to restore the lungs to the performance of their natural functions.

Metal Sockets for Old Poles.—A pole is most subject to decay at the ground line. Hence, a company has recently devised a scheme for renovating the old poles by furnishing them with steel sockets at the ground line. The repairs can be effected without disturbing the electrical circuits. The pole is cut away at the decayed point and supported temporarily to one side. The stump is then removed and a steel socket is fitted into the ground. This is partly filled with earth and then a thick grout is poured into the upper part. When the pole is slipped into this socket it causes the grout to squeeze up around the sides, making a perfect joint.

Electric Ovens in Vienna.—Electric ovens for bread baking are beginning to make their appearance in some of the large cities of Europe, and the central electric stations are promoting their use. The Vienna electric plant is making arrangements with the bakers' syndicate to have electric ovens adopted widely throughout the city, and it offers to supply the current for this use at special reduced rates. As the bakers' ovens run all night this provides an outlet for current during the hours when the load is normally low. There will soon be a trial oven put in operation in order to test the method.

Artificial Transmission Line.—In the laboratory of the Graduate School of Applied Science of Harvard University, an artificial power-transmission line has been installed which may be connected up to represent a single-phase power line 2,400 kilometers (nearly 1,500 miles) long or a three-phase line of 800 kilometers (500 miles). Each of the three sections of this line is made up of 10 inductance coils and the equivalent of 10 condensers. By using currents under pressure of 100 volts the action of an actual transmission line bearing current at 100,000 volts may be studied. The results obtained from the small model will be practically the same as in a full-sized transmission line, with the exception that certain over-voltage phenomena are not represented in the small model.

One Hundred and Forty Thousand-volt Transformers.—Twelve single-phase, 60-cycle, 3,000-kilowatt transformers are being built for delta connection on the 140,000-volt transmission system of the Eastern Michigan Power Company. These transformers will occupy a floor space of 11 by 5 feet and will reach to a height of 19 feet from the floor to the top of the high-tension terminals. Each transformer will contain 4,000 gallons of oil. Three of the twelve transformers are designed for a secondary voltage of 2,470 volts in one circuit. Three transformers are designed for simultaneous service on four secondary circuits of 370 volts, with 125 kilowatt capacity each; one secondary circuit of 5,560 volts with 1,000 kilowatt capacity, and one secondary circuit of 44,000 volts with 1,500 kilowatt capacity. Three transformers are designed for one secondary circuit of 370 volts with 125 kilowatt capacity, one secondary circuit of 5,560 volts with 2,250 kilowatt capacity, and one secondary circuit of 2,200 volts with 500 kilowatt capacity. The three remaining transformers are designed for two secondary circuits of 370 volts and 125 kilowatt capacity each, and one secondary circuit of 22,000 volts and 2,750 kilowatt capacity. Oil-filled leads are used, having an over-all dimension of 7 feet 4 inches, and containing 30 gallons of oil each. The transformers are designed to withstand a test of 280,000 volts from the high tension winding to all other parts.

Aeronautics

Wind Velocity in Gale of February 22nd.—According to the report of the New York Weather Bureau the highest velocity attained by the wind in the gale which swept the Eastern States was 96 miles per hour for a period of five minutes, while for a period of one minute a velocity of 110 miles per hour was indicated. The first-mentioned figure is 13 miles per hour higher than has ever been recorded before.

Tabuteau's New Two-hour Distance Record.—Not to be altogether outdone by Vedrines, Maurice Tabuteau, on the 23rd ult., above the same aerodrome (at Pau, France) covered 227.454 kilometers (141.24 miles) in 2 hours, thus beating by 22.167 kilometers his record of January 24th for the same period of time. Tabuteau flies a Morane-Saulnier monoplane with which, in this latest trial, he maintained a speed of 70.62 miles an hour.

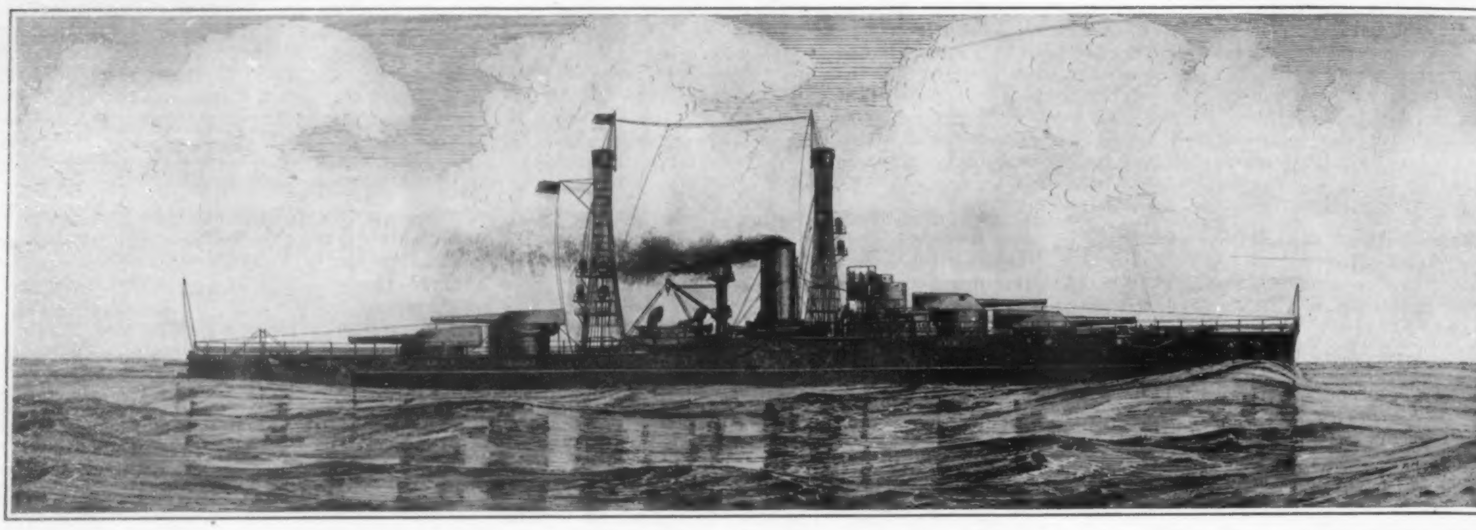
Fatal Accident from a Broken Propeller Blade.—At Pau, France, on the 23rd ultimo Lieut. Ducourneau fell from a height of 450 feet and was instantly killed when a propeller blade of his monoplane broke. As far as we recall, this is the first fatal accident due to the breaking of a propeller on a monoplane. With a biplane, where the propeller is in the rear, a broken blade is liable to damage the rudders and produce a serious result.

The Kaiser Encourages Motor Builders.—The Emperor William has just offered a prize of $12,000 from his private funds in order to encourage the building of motors for aeroplanes in Germany. The prize is to be awarded at the end of one year to the inventor of the best motor. Capt. Hildebrand, a well-known aeronaut, states that the Emperor desires to promote the building of motors in Germany so that it will not be needed to import them so largely from other countries, such as France. He has already devoted as much as $50,000 for scientific aeronautic work, and has not ceased to show his interest in this subject.

Automobile vs. Aeroplane.—Our frontispiece this week is a striking picture of a race between Charles K. Hamilton, America's premier pilot, on a standard Curtiss biplane, and a high-powered automobile. The race was a straightaway dash along the shore on the Gulf of Mexico, at Galveston. It was, of course, won by the biplane, which beat the auto by a liberal allowance. A similar race occurred at Tarrytown, N. Y., on and over the frozen surface of the Hudson River, a few weeks ago, and in that instance also, over a 4-mile course, Clinton O. Hadley, on his biplane, beat an auto racer. Such events are frequently held on circular tracks when exhibition flights are given, and in well-nigh every case the aeroplane finishes the winner.

Italian Military Aeronautics.—Italy was the first country which had occasion to use aeroplanes in actual war in Tripoli, and the result was interesting. The aerial fleet has only forty aeroplanes and pilots at present, but there will soon be many more added, and owing to a good organization the question of army aeroplanes is to be rapidly developed. At present there are three military grounds in Italy, one on the Ticino River, one at Avanio, and a third at Pordenone. Three others are soon to be installed. As regards airships, it may be mentioned that two small airships of 5,000 cubic yards were used at Tripoli. Italy now has three airships of this size, and is soon to have three others of 15,000 cubic yards. While the airships are built at the military shops, the aeroplanes have to be ordered from France, but it is hoped to build them at home in the near future.

Military Aviation at Home and Abroad.—At the present time our army has but seven aeroplanes as against some 200 owned by the French war department. Recently a small appropriation of $75,000 was stopped by the Democrats in the House, whereas in France $1,500,000 has been appropriated and the government has been asked to bring the total up to $4,500,000. It is proposed to have a complete aerial regiment with 234 pilot officers, 210 observers, 42 mechanics, 1,710 non-commissioned officers and 550 privates. This regiment will be distributed throughout the military centers of France. It is also proposed to build enough sheds to house several hundred aeroplanes. The new scheme has aroused great public enthusiasm and each city is expected to contribute toward it. Last year in the United States, about $60,000 of a $125,000 appropriation was expended for aeroplanes. It is to be hoped that our Congressmen will take up the matter with some of the enthusiasm displayed by the French, and that our government will not lag behind as it has done during the past year or two. Germany has appropriated $4,000,000 for aviation this year, and only last week, when the British army estimates were made public, it became known that Great Britain has set aside $800,000 for this purpose. An international competition for military aeroplanes, with prizes totaling $55,000, will be held in England next June.



Length, 583 feet. **Beam,** 95 feet $2\frac{5}{8}$ inches. **Draft,** 28 feet 6 inches. **Displacement,** 27,500 tons. **Fuel,** oil exclusively. **Speed,** $20\frac{1}{2}$ knots. **Armament,** ten 14-inch guns. **Torpedo tubes,** four 21-inch. **Armor belt,** $13\frac{1}{2}$ inches; barbettes, 13 inches; turrets, 9 to 18 inches. **Smokestack,** 13 inches. **Conning tower and tube,** 16 inches. **Gun deck,** 3 inches. **Protective deck,** 2 inches.

THE NEW UNITED STATES BATTLESHIPS "NEVADA" AND "OKLAHOMA"

Our Latest Battleships, the "Nevada" and "Oklahoma"

The Most Powerfully Protected Ships Yet Designed

THE navy has every reason to be pleased with the design of our latest battleships, the "Nevada" and "Oklahoma," contracts for the construction of which have recently been let to the Fall River and the United States shipbuilding companies. These ships represent, to a greater degree than any of their predecessors, the united experience and thought of the various branches of the naval service; and the officers of both line and staff unite in the belief that these two ships are the most powerful vessels afloat or under construction to-day. The armor plan is particularly effective and decidedly original, and in a comparison with previous vessels it will be noted that there are some very radical departures from existing practice.

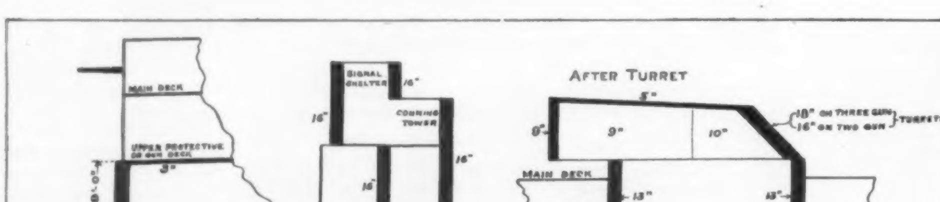
The "Nevada" and "Oklahoma" are 500 tons larger than their immediate predecessors, the "New York" and "Texas." The principal dimensions are: Length over all, 583 feet; beam, 95 feet $2\frac{5}{8}$ inches; mean draft, 28 feet 6 inches. On this draft the displacement will be 27,500 tons. The "Nevada" will be driven by Curtis turbines and the "Oklahoma" by reciprocating engines. The boilers in both ships will be fired exclusively with oil, and they will carry no coal. The estimated speed is $20\frac{1}{2}$ knots.

In an article published in the SCIENTIFIC AMERICAN of January 27th, 1912, we dealt at some length with the armament of these ships, and showed the considerations which led to the adoption of the three-gun turret, the chief of which was that, by elevating, training and firing the three guns together, great assistance will be rendered to the spotter in determining the fall of the shots, and he will be able to telephone the corrections with much greater accuracy than he could if the guns were fired separately. The armament will consist of ten 14-inch guns, carried in four turrets, disposed as follows: On the forecastle deck will be first a three-gun turret, then a two-gun turret. On the quarter deck will be a two-gun turret and astern of that a three-gun turret. This arrangement will give a concentration of fire superior to that obtainable from the ten 14-inch guns of the "New York" and "Texas," which will be mounted in five two-gun turrets.

The new 14-inch, 45-caliber gun is a far more powerful weapon than the 45-caliber, 12-inch gun, mounted on the "Delaware" and "North Dakota." The muzzle energy of the 12-inch piece is about 49,000 foot tons, whereas that of the 14-inch piece is about 66,000 foot tons. Moreover, its shell, which weighs 1,400 pounds as compared with the 870-pound weight of the 12-inch, carries a much larger bursting charge of high explosive and, therefore, will be proportionately more destructive.

The principal interest of the new ships lies in their great defensive power. Not only will they carry a much greater weight of armor than has been carried, or is to be carried, by any ship built or building, but the armor will be disposed to greater advantage. The chief duty of a warship is to maintain her stability and her mobility, and at all times present a completely-protected emplacement for her guns. In other words, she must not only carry her guns into the fight but she must nurse them through all its savage hammering, so effectually that they shall be able to pour shell into the enemy until they have silenced or sent him to the bottom.

So let us see how these conditions have been met in our new ships. Taking the "North Dakota," for instance, as a basis of comparison, we find that the armor protection has been entirely removed from the secondary battery of 5-inch guns—a wise step, which might well have been taken several years ago. For it is a fact that the 5, 6 or 7 inches of armor with which the secondary batteries of warships of to-day are protected, will simply serve as a shell-burster, delaying the high explosive 14-inch shells long enough to cause the little firing hammer within the shells to leap forward and detonate the high explosive, the burst taking place after the shell has passed through the armor and is well within the body of the ship. So the torpedo-defense guns will have nothing in front of them except the ordinary ½-inch or ⅝-inch plating of the ship's side, which may very well allow the shells to pass through without bursting among the gun crews crowded about the guns.



The armor plan of the "Nevada" and "Oklahoma," the two most powerfully protected ships yet designed.

The most important armor on a ship is undoubtedly the belt armor upon the hull itself; for to this is committed the duty of keeping the ship afloat and preventing projectiles from striking a vital blow in the magazine, boiler rooms or engine rooms. In the new ships the belt will be $17\frac{1}{2}$ feet in width and, at mean draft, it will extend from 9 feet above to 8 feet 6 inches below the water. It will have the unprecedented thickness of $13\frac{1}{2}$ inches, which it will maintain from its upper edge down to within a few feet of its bottom, where it will begin to taper to a minimum width at the bottom of 8 inches. Very rarely, if ever, will the bottom edge of this deep belt be rolled out of water, exposing the thin plating below. This belt will extend for over 400 feet along each side of the ship. It will terminate well forward of No. 1 barbette, where it will be carried, with the same depth and thickness, entirely across the ship. At its after end the belt armor will be carried at its full depth of $17\frac{1}{2}$ feet to a point about 30 feet aft of No. 4 barbette. Here there will be a jog, the depth of the belt decreasing from $17\frac{1}{2}$ feet to $8\frac{1}{2}$ feet, at which depth it will be continued aft for another 60 feet. Transverse bulkheads of the same thickness as the belt will here be carried across the ship.

An important feature of the side armor is the manner in which the plating will be laid on the ship. Hitherto the armor has been placed horizontally, in two strips, with a continuous horizontal joint, located slightly above the water line, between the upper and lower strip. This had the disadvantage that it presented a continuous line of cleavage, near the water line, and, therefore, at a most vulnerable point. In the new ships the armor plates are laid vertically, the joints being vertical and the plating extending the whole depth of the belt without any continuous joint at the water line. This is a most important improvement which will add greatly to the protective

(Concluded on page 225.)

An Important Development of the Steam Engine

Superheat as an Element of Efficiency

By Warren H. Miller

THE German "locomobile," or superheated steam unit, the subject of this article, is no recent invention. There are at the present moment over 54,000 of them at work, aggregating 1,800,000 horse-power, distributed throughout Europe and her over-sea trade dependencies. Not one of these uses over 1½ pounds of coal to the horse-power-hour of work, while the world's record in coal economy to-day is held by a small 140-horse-power locomobile superheated steam unit delivering a horse-power on seven-tenths of a pound of coal. These figures are revolutionary; how revolutionary one begins to realize after looking over our own field and seeing the average saturated-steam engine using four to five times this amount of coal. We are not dealing here with a single invention, but rather with a big industrial movement in Europe, an epoch of advance in the scientific use of steam; and America, with her great mechanical genius, cannot afford to be left behind.

Briefly, the remarkable economy of these engines is due to the elimination of the cylinder condensation waste, increasing the efficiency of the steam itself, and eliminating all minor wastes such as radiation, boiler feed, etc. The net result of these is to bring down the steam consumption, which in small saturated-steam engines is about 25 to 30 pounds of steam per horse-power per hour, to less than 10 pounds. As a natural consequence the boiler required drops to one-third the size formerly requisite, reducing with it also the up-chimney loss to one-third. As a matter of plain fact the German superheated steam engine will deliver the same horse-power using only the heat that we waste up the stack, which is about one-fifth the total heat in our coal pile.

The value of superheated steam lies in the fact that its non-conductivity decreases and virtually eliminates cylinder condensation, and at the same time the volume of steam per pound is much greater than with saturated steam, so that we get more work out of it. Each fresh puff of saturated steam as it enters the cylinder encounters the comparatively cold walls left by the previous exhaust. Naturally part of it condenses —in figures, a third of it—and much of this condensed steam in the shape of water is swept out with the next exhaust and does no work. In other words, in an ordinary steam engine one-third of all the steam made, and one-third of all the coal burned, is wasted because of cylinder condensation. To eliminate this loss the steam is superheated, that is, heated far above its natural temperature at the boiler gage pressure. When it enters the cylinder it will by no means cool off as readily as before, besides which it has heat reserve enough to remain in the shape of steam, so that all of it does useful work.

Fig. 1 shows the simplest possible engine using superheated steam to eliminate cylinder condensation. It looks like our familiar agricultural engine, but it is quite different. This one will thresh your wheat for 27 cents a day while ours in the same size, 15 horse-power, will cost us about $1.37. This very engine (that is, one just like it) does all the work on a sugar plantation down in the forests of Venezuela; it reaps the cane, comes into the shop to run the bagasse mill; and, between jobs, cuts and saws lumber in the forest. It is run by native Venezuelans and the fires are fed with wood shooks and crushed cane. It is a simple superheated steam engine, and as the compound is only a trifle more complicated you will get them both by a glance at the longitudinal section in Fig. 2. This is a section of that world-beater which holds the seven-tenths-pound steam consumption record, one of this type furnishing the electric light and power for the Czar's new palace at Peterhof, Russia.

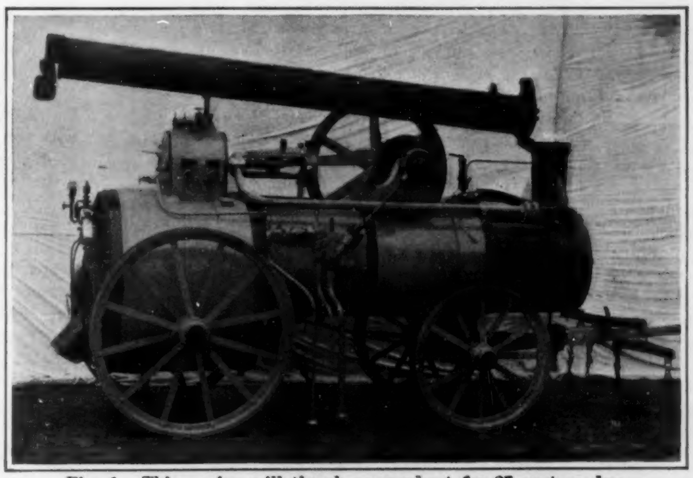


Fig. 1.—This engine will thresh your wheat for 27 cents a day.

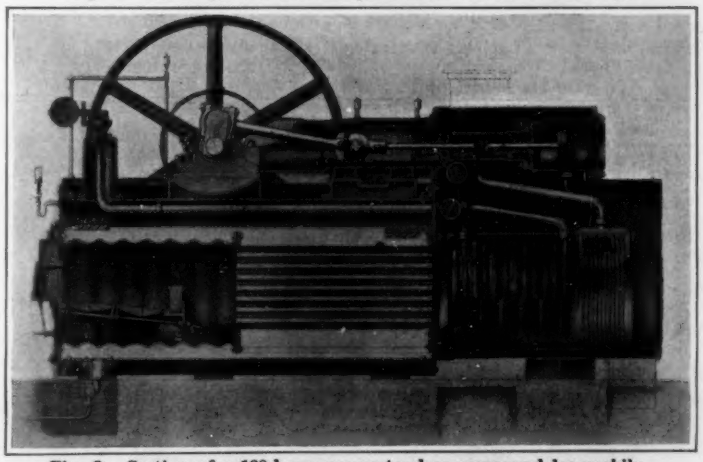


Fig. 2.—Section of a 138-horse-power tandem compound locomobile.

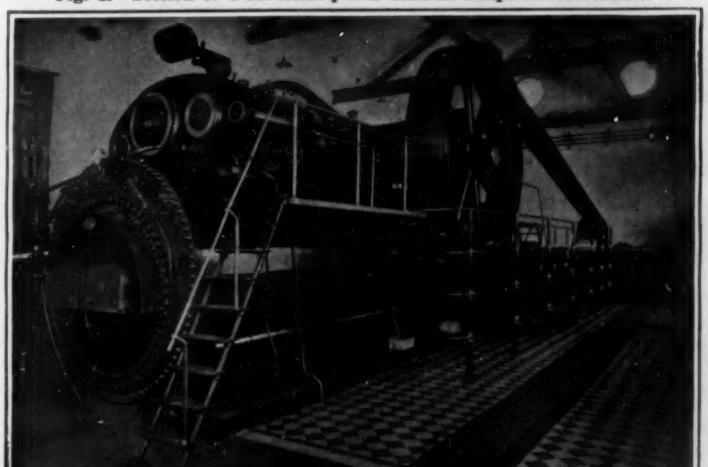


Fig. 3.—A 200-horse-power cross compound locomobile driving two dynamos in parallel.

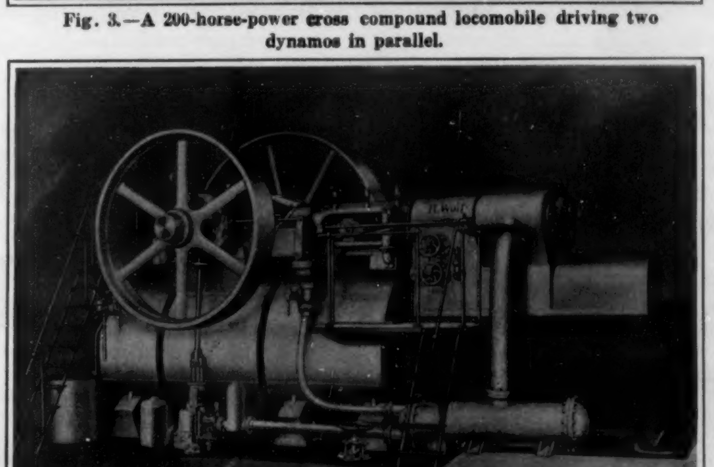


Fig. 4.—A 580-horse-power locomobile furnishing electric power for a German steel plant.

NEW STEAM ENGINES

Note, first of all, the position of the high and low pressure cylinders. They are located in the smoke flue, not by way of novelty in location, but because that is where the waste chimney gases can surround them and be utilized in warming the outside of the cylinder walls, thus further reducing cylinder condensation. Note the two superheater coils in the forward portion of the boiler shell. Now, in planning a boiler you can either leave the tubes long and use all the heat in evaporating saturated steam, as is our practice, or you can make them shorter so that the burning gases will come from them very hot, and this high temperature is used to superheat the relatively smaller amounts of steam evaporated, by passing the gases over these coils. This latter design the German mechanical engineers have developed. In our case we need about thirty pounds of saturated steam evaporated to get a horse-power of work out of the engine; with the locomobile, only ten; and hence the boiler need only be one-third as large as in our engine. One naturally wonders if the same total amount of coal will not have to be burnt in either case, since the superheated steam has to be so much hotter, but such is by no means the case and for two good reasons. Four-fifths of the heat which one puts into water to make steam is expended as "latent heat" before any kind of steam at all can be made, after which it can be raised to any temperature with comparatively little more expenditure of heat. Again, there is nearly a third more useful work in a pound of highly superheated steam than in the same pound of saturated steam at the same pressure because it occupies that much more specific volume. The resultant of these causes combined is that more than twice as much horse-power is available by the German arrangement of the boiler.

This matter of reducing the steam consumption of the engine is a two-edged sword, for it not only reduces the boiler dimensions needed but the coal losses in the boiler as well, such as the loss of waste gases up the stack, the radiation, the boiler feed expense, and the necessary condenser outlay. They are all only one-third as great in a locomobile unit as in the ordinary engine and boiler of the same size, so that we find the actual total coal expense one-quarter to one-fifth that of our usual steam plant.

Let us turn from thermodynamics and see how all this is done in the locomobile itself. The saturated steam from the boiler enters the first superheated coil and is heated by flue gases in the shell up to about 570 degrees Fahr. It then passes direct into the high-pressure cylinder of the engine without having to pass through any long lines of steam piping exposed to the air, and, entering the cylinder, expands against the piston, doing work. This cools it down, as is also done by the walls of the cylinder in spite of the waste heat jacket. But the steam is too hot to condense, so that at the end of the stroke you still have a cylinder full of steam at low pressure, but none of it has been condensed into water which cannot do useful work. If now you let it into the low-pressure cylinder a third of it would again have

to condense on the walls, since it is now cooled down to saturated steam and is in the same condition as the steam which we use in ordinary steam engines. But instead, the exhaust of the "high" is sent to the second set of coils, placed just after the first set, where it is again superheated, this time to about 400 degrees, the temperature of the steam itself being only 235 degrees when it leaves the high-pressure cylinder. Thus reheated, it is admitted to the low-pressure cylinder and expands against its piston right down to the vacuum of the condenser, arriving there in an exactly saturated condition, not having lost a drop by condensation. In the condenser, its work having been done, it is instantly condensed to water, producing the vacuum which is of such essential importance in the economy of any compound engine.

This, in a word, is the whole history of the use of superheated steam in a locomobile.

It must not be supposed that all these economies were obtained without a long struggle against the practical difficulties of using superheated steam. Since 1891 it has been a slow industrial advance with half a dozen large engine builders of the first caliber behind it; to say nothing of such able firms as Krupp, Bollinckx, and Tosi who were developing slow-speed ventil-geared engines for superheated steam at the same time. Gradually, through trial, failure and partial success, engines have been developed capable of ordinary everyday service in meeting the practical requirements of superheated steam. It is a subject on which most American engineers have but little practical knowledge. This steam at 570 deg. Fahr. is so hot as to carbonize any but special lubricating oils. It will char all soft packings of the piston and valve rods, and melt many of the soft-metal packings ordinarily used. Any attempt to use it in an engine designed for plain saturated steam, as has often been tried in this country, is bound to result in failure. One of the largest makers in Europe, a firm that has already turned out over 22,000 locomobiles averaging two to three hundred horse-power each, has overcome the lubricating difficulty by designing so as to require none, precisely as in large marine steam engines. The valve is a specially designed piston-valve with cast-iron rings and a cast-iron bushing, which soon acquires the well-known diamond-hard, glassy surface of cast-iron wearing on cast-iron in the presence of steam. Another manufacturer whose output of locomobiles exceeds 24,000 running up to 1,000 horse-power in size, uses a special adaptation of the "ventil" or poppet-valve gear. This is simply a steam poppet valve lifted off its seat by a suitable cam and having therefore no sliding friction.

As to valve rod packing, the locomobile manufacturers have avoided trouble with it by the simple solution of having none at all. You can harden the surface of steel rods and then grind them into chilled steel bushings so as to produce a tight fit, provided that you turn shallow rings on the surface of the rod, making what is known as "labyrinthine packing" wherein the steam blocks itself as it were in the ring spaces and condenses before it can get out. In one make of locomobile the valve rod is on the exhaust steam side of the valve. The bushings are very long in proportion to the diameter of the rod, yet the friction is so little that very light and sensitive governors can be used on these engines. The piston rods are packed by a cast-iron labyrinthine cage which operates on somewhat the same principle; each exhaust stroke draws out from the inside all the steam which forced its way into the rings of the labyrinth during the previous steam stroke, so that the steam never gets a chance to escape to the outside air. Expansion strains are provided for by making the frame open and free to extend without introducing internal stresses anywhere, and, in the piping, wrought iron with steel fittings have been adopted in place of brass and copper, as the last lose considerable strength at the temperature of superheated steam.

We illustrate here a few typical plants: Fig. 4 shows a 580-horse-power locomobile with double superheat and condenser.

Fig. 3 is a 200-horse-power compound locomobile with both high and low pressure cylinders cast in one piece with the steam dome, being jacketed by the live saturated steam of the boiler, so that radiation from the cylinder is returned direct into the steam. This is a favorite form of jacketing with one of the largest firms, and its engineers prefer it to jacketing with waste heat from the flue gases in the stack. The list below will give some idea of the distribution of these engines in the industries. It is the sales list of just one company. There are at least two others which can equal this, both in horse-power and number of engines.

Woodworking trades	1,885	Milling trades	1,253
Ceramic trades	1,400	Mining trades	837
Iron and metal works	1,429	Paper and printing works	224
Building trades	337	Quarries	167
Electric lighting and power stations	1,615	Textile industry	337
Total			9,484

Four-dimensional Space

Its Application to Practical Problems

By E. L. Du Puy

IN ordinary geometry we study the straight line, which has one dimension only; the plane, which has length and breadth; and lastly, solid bodies, in which we have to consider length, breadth and height. Mathematicians, with their characteristic spirit of generalization, after having studied the systems enumerated above, have been led to conceive—in a purely theoretical way, of course, without giving any thought to any possible physical realization—bodies which could be completely described only by specifying four magnitudes, length, breadth, height and extension. This last dimension corresponds to nothing that our senses are capable of perceiving in combination with the other three dimensions; but in combination with any two of them it forms three-dimensional space, analogous to that in which we live.

It is possible to arrive at the conception of this four-dimensional space by purely physical considerations, as has been shown by the illustrious French mathematician, Henri Poincaré, in his remarkable book, "Science and Hypothesis." When we look at any solid body, its image is formed upon our retina, which, of course, extends in two dimensions; what we have here is a representation in perspective. If the object under consideration is allowed to move with respect to our field of vision, we see a series of perspective views which, with the assistance of various muscular sensations and our sense of touch, enable us by unconscious synthesis to form an idea of three-dimensional space, derived from a series of two-dimensional views succeeding one another according to a definite law.

An analogous line of reasoning enables us to represent to our minds a body of four dimensions; in fact, the perspective view of such an object would be a three-dimensional solid. We can, therefore, form as exact a representation of the four-dimensional body as we please, and from this pass on to a conception of the object itself.

The space thus defined can be and has been made the subject of numerous applications, both mathematical and physical. We shall say nothing with regard to the former class, the examples of which are exceedingly numerous, and which, moreover, require more intricate mathematical treatment than can be rendered here. We shall restrict ourselves to a number of examples showing the application of space of more than three dimensions to the study of chemical systems. Here this application has been the outcome of the use of the method of Cartesian co-ordinates. Let us consider all possible mixtures of any two substances, such as, for example, lead and tin. On any straight line AB divided into one hundred equal parts we shall always be able to locate a series of points M, such that, the length AM being proportional to the percentage of lead in the mixture, the segment MB will represent upon the scale of the drawing the percentage of tin. Our system is, therefore, represented in this case by a figure of one dimension.

If, now, we are to represent in our diagram a property of a mixture, for instance, its solidifying temperature, as a function of the composition, all that is

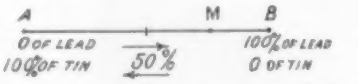


Fig. 1.—One-dimensional line diagram for mixture of two components.

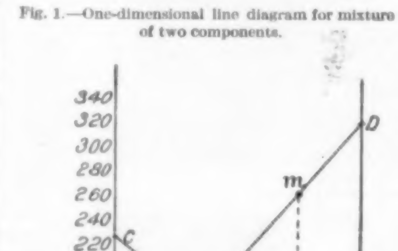


Fig. 2.—Melting point curve for a binary mixture represented in the line diagram, AB.

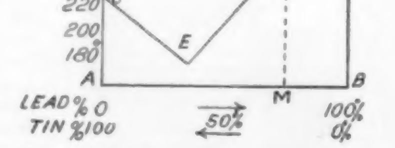


Fig. 3.—Gibbs' two-dimensional triangle diagram for mixture of three components.

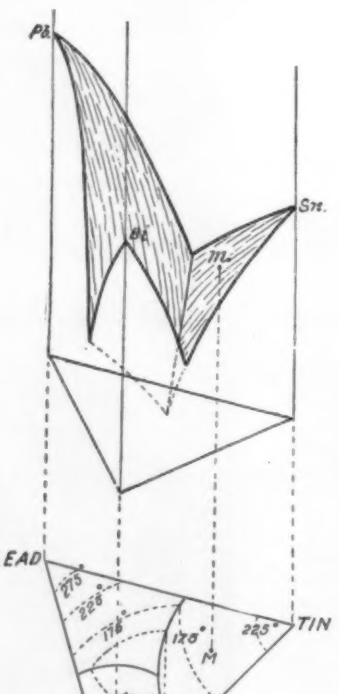


Fig. 4.—Ternary diagram in perspective and projection.

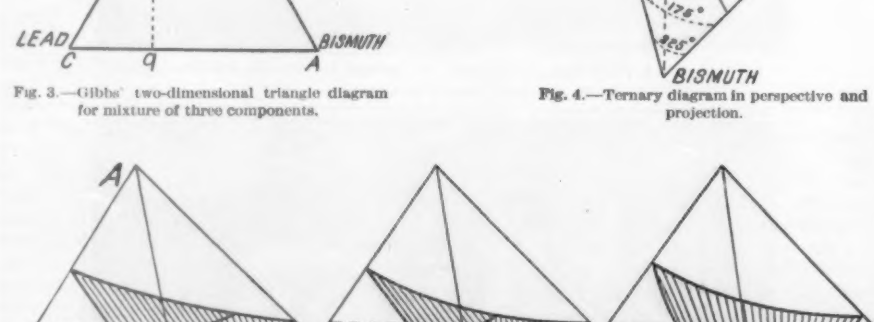


Fig. 5.—Three different aspects of a tetrahedron diagram for a mixture of four components. Isothermal surfaces for the system: water, ethyl alcohol, NaCl, Na_2SO_4.

DIAGRAMS FOR REPRESENTING MIXTURES AND THEIR PROPERTIES

necessary is to draw at every point, such as M, of the line $A\,B$, a perpendicular $M\,m$ proportional to the corresponding temperature. The join of the extremities of the perpendiculars will furnish a curve, such as $C\,E\,D$, by the aid of which may be deduced from a limited number of experiments, and recorded upon the two-dimensional diagram, the melting points of all possible mixtures of the tin and lead.

Let us now consider a mixture of three bodies: lead, tin and bismuth, for example. In order to represent this system we shall make use of Gibbs' two-dimensional triangle diagram. Let us represent by each of the three apices of an equilateral triangle one of the three metals entering into the alloy. The sides of the triangle then represent in the manner just explained binary mixtures. Let M be any point in the interior of the triangle. Consider the three distances $M\,p$, $M\,q$, $M\,r$. It is known to mathematicians that $M\,p + M\,q + M\,r =$ constant. If we give to this constant the value of 100, it will be seen that the point M will be the representation of an alloy containing

$M\,p$ per cent of the metal A,
$M\,q$ per cent of the metal B,
$M\,r$ per cent of the metal C.

If now we wish to represent a property of the mixture, such as, for instance, its solidifying point, we must draw at each point M a perpendicular $M\,m$, whose length is proportional to the temperature in question. The totality of the points m then form a surface. Our representation is a three-dimensional figure. We can, however, in various ways, give expression to this by means of a surface of two dimensions; for instance, by means of a drawing in perspective or by means of a system of contour lines of the curved surface, such as are employed in indicating upon a map the relief of the earth's surface.

Let us now consider a system containing four constituents, as, for example, a special steel, containing in addition to iron and carbon, such a pair of elements as silicon-manganese, nickel-vanadium or chrome-vanadium. (It should be remarked that no complete investigation has as yet been made of such systems, owing to the incompleteness of our knowledge regarding the ternary systems of which they are composed.) Our former representation will now no longer suffice for our purpose, and we shall be forced to make use of an equilateral tetrahedron, any interior point of which represents a definite percentage of the mixture. The four corners of the solid figure represent the pure constituents. The edges represent binary mixtures, and the faces ternary mixtures. Let us now attempt to represent the solidifying temperature as before. We find ourselves in a peculiar predicament, for the problem before us is to draw at the point M a perpendicular to the tetrahedron, in such direction that this line shall meet none of its faces, or, in other words, in such manner that it shall issue from within the solid without passing through any of its faces. There is only one way out of the difficulty, namely, to construct our diagram in space of four dimensions; but how are we to represent this to our mind? We must construct a series of tetrahedra, representing the mixture; on each we must mark the points M corresponding to a composition, the solidifying point of which is some selected temperature. These points, when joined together, form a series of surfaces, each of which separates at a given temperature the liquid zone from the solid zone.

It must not be supposed, by the way, that the number of dimensions taken in view by mathematicians is limited to four; it is in fact unlimited, for, continuing successively the line of argument indicated above, with each fresh constituent a new dimension is introduced. Some mathematicians have even gone so far as to speak of fractional dimensions.

Enough has been said to show that the conception of hyperspace is not an absurdity, but that, quite on the contrary, it is capable of rendering the greatest practical service to science.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Life-nets at Niagara

To the Editor of the SCIENTIFIC AMERICAN:

Has not Niagara taken toll enough of human life? It seems astonishing that the best mechanical brains of the land have not before this attacked the problem of adequate life-saving devices for the river above and the rapids below the cataract.

In the first place, there should be created by joint action of Congress and Canadian Parliament an international Niagara Life-saving Commission. A patrol of picked men from the provincial and New York State police forces, respectively, should be formed. These should do much more than is now being done to prevent the reckless, the intoxicated, the ignorant and the unwary from getting into dangerous situations. Had such a force kept the people from the ice-bridge, we would have been spared the heart-rending tragedy of Sunday, February 4th. But it is not to be supposed that human nature will cease to take risks, and therefore from time to time the multitude will be telephoned up to throng the banks and watch the terrible spectacle again. When these times come there should be something more than loose rope-ends dangling from the bridges as a basis of hope for those who are going down to death.

Simple and perfectly practicable is a long life-net on each bridge, extending the length of the bridge over the water, each net to be 6 or 8 feet wide, with meshes large enough for clinging hands and feet, and suspended by tested ropes from a steel rod running the length of the bridge and connected with a powerful motor. The nets should hang, edge down, at the very surface of the water. Then, when a helpless boat comes drifting toward the fall, the occupants, as the boat strikes it, can easily seize the net, climb upon it, the bridge-motor will be started, the steel shaft will wind up the ropes and the net with its human burden be raised in safety to the bridge floor.

Through the influence of the SCIENTIFIC AMERICAN, these suggestions or better ones ought at once to open the way to action, else the death-roll goes right on.

Malden, Mass. HENRY J. KILBOURN.

"Suction" as a Cause of Collision

To the Editor of the SCIENTIFIC AMERICAN:

The accident to the British cruiser "Hawke," pictured in a recent number of the SCIENTIFIC AMERICAN, and the inquiry into the cause of the accident, are most interesting. On the shallow waters of the Mississippi River the effect of suction is well known to every navigator. We have a canal here with about five feet of water and some large boats. These boats are obliged to go at a snail's pace through the canal, because if forced at all they cannot be steered. I have often watched such a boat from her deck, and seen the effect on her of the wave that follows and precedes the boat.

As soon as she is forced, unless exactly in the center of the deepest water, a wave piles up on one side of the bow or the other. This wave boxes her off her course; so that, unless stopped and the wheel set to backing, she turns at right angles to her course. I was on a boat one night going through the canal, and the boat was loaded down deep for such a boat. We went along at a slow crawl; but every now and then the boat would take a sheer from one side or the other. The pilot would stop the engine and set her to backing, and after getting her straight would start on again. This happened every quarter of a mile, and was exhausting to the pilot. I remember well his exasperation and his remarks. "You are a hog, 'Mary,'" he would say. "You are a hog." It seemed to relieve him to express his feelings that way, and yet that boat in deeper water steered as well as any.

Once I witnessed the very thing that happened to the "Hawke." It was on the famous river trip that President Roosevelt made down the river to Memphis. Leaving Cairo, there was a mob of boats none too well disciplined, and among them one of the largest towboats of the Ohio River. This boat was a bully among the smaller boats, and arrogated to herself and owners the position of honor next the president's boat, though she had been assigned a humbler place. By dint of weight, size, and strength, she took what she wanted, and there was no means to make her obey the laws of decency. As the fleet were leaving Cairo she started off to capture the best place, and was raced by a swift little boat out of the Illinois River. The little boat gained on the big one, and would have passed her had not the big one pinched her toward the shore. Suddenly the thing happened that occurred to the "Hawke." The little boat, caught with the bank of the river on one side and pulled by the suction of the larger boat, suddenly was sucked up against the larger boat's side and stuck there, and, as long as they kept going, no power could separate them. The little boat was captured like a satellite by a planet, and as they went along together she stuck to the big boat like a barnacle, and having about as much effect on her as a barnacle would.

It was only by stopping the engines of the little boat that they were able to get away, and then they nearly got under the wheel of the bigger boat. It is well known on this river that two boats, racing, will lock together and stay locked if allowed to come too close.

In the "Hawke" affair it seems evident that the wave piled up on the shoal side of the "Hawke's" bow and the bigger boat captured her, head on this time, to the damage of both the "Hawke" and "Olympic." I guess it was a case of racing and the big boat bullying the little one and crowding her into shoal water. There are gentlemen and there are bullies both afloat and ashore. The latter class is not unknown out here.

Keokuk, Iowa. M. MEIGS.

An Explanation of the Olympic-Hawke Collision

To the Editor of the SCIENTIFIC AMERICAN:

The very interesting article in your issue of February 24th, with reference to the collision between the "Olympic" and the "Hawke," emphasizing the value of a knowledge among maritime officers of the existence of the force designated as "suction," inspires the following explanation. It would appear that the term "suction" is a misnomer. Every boy who has sailed boats on a pond knows of this force, but suction would be difficult of demonstration in this connection. Science has long recognized the fact that our earth is enveloped in a magnetic, or electric, field, as is everything on its surface; that the magnetic currents have definite direction; that all force is in a sense electrical; that all cells have polarity; that unlike poles attract, while like poles repel. Two vessels in proximity are evidently in the same magnetic field and have similar polarity. Taking the established fact that as one vessel approaches to pass another, the bow of the forward ship turns from the "overtaking" vessel, and, as the latter passes, a reverse movement occurs, we have first the attraction, let us say, between the positive bow of the "overtaking" vessel and the negative stern of the forward ship; as they come abreast, the effect is neutralized, they lie parallel, and the drift brings them closer together; then, as one forges ahead, again occurs the attraction between the opposite poles of the stern of the one and the bow of the other, drawing the bow toward the passing ship. This may be practically shown by means of two magnetic needles, which for the purpose of demonstration may represent the respective vessels. As one approaches and passes the other we will have the following phenomena of magnetic attraction: The larger needle, or vessel, will exert the stronger force, and maintain more nearly its own equilibrium. With the needles, if one is somewhat larger than the other and moves steadily by it, though both will be deflected, the smaller will swing fully forty-five degrees, and in the case of two moving vessels a collision will naturally follow.

Roanoke, Va. F. C. TICE.

Steering Aeroplanes

To the Editor of the SCIENTIFIC AMERICAN:

The article entitled "Difficulties in Steering Aeroplanes" in the February 10th number of your paper, written, as its author says, to draw out discussion, is not very clear as to what he means. Gyroscopic force has been suggested to keep the aeroplane in its course while here it is said to cause the machine to travel in a circle.

The writer also says the machine turns the opposite way to the motion of the propeller. The propeller turns on a horizontal axis while the machine in turning right or left turns on a perpendicular axis. Then which is the "opposite way?" If he means opposite the way the top of the propeller is going why opposite the top more than opposite the bottom?

Is it not just possible that in his case the propelling power is not located exactly in the center of resistance?

Niles, Mich. W. G. BLISH.

A Turntable Airship Shed

To the Editor of the SCIENTIFIC AMERICAN:

As a constant subscriber to your paper for a number of years, I have been deeply interested in your accounts of the progress of aerial navigation, and have followed its development as they were made from time to time. As the dirigible airship has been brought to greater perfection, and the size has increased greatly, the difficulty of getting them in and out of the shed in a cross wind has caused a lot of trouble, and a number of wrecks. Now it has occurred to me that a very simple way out of the difficulty would be to have the shed mounted as a turntable, so that it could be turned to face the wind, and the airship could then be taken in or out head to the wind at all times. It might be manually operated, or run by a small motor. As this seems such a simple and easy way out of the difficulty, I send the suggestion with the hope that at least one step more may be made in the art.

A. C. LAWRENCE.

[The idea suggested by our correspondent has already been carried out by the Siemens-Schickert Works. The "Krell I," built by the firm, is housed in a shed that swings on a turntable.—EDITOR.]

A Mechanical Violin Player

How a Bow with 3,000 Horsehairs Solved a Difficult Problem

THE feat of inventing a piano which can be played by mechanical means and which can reproduce with fair accuracy not only a great artist's technique, but also his interpretation, was accomplished only after thirty years of thinking and model building. The automatic piano players now on the market leave very little to be desired in the way of performing good piano music. However preferable the performance of a great virtuoso may be, because the effect of his personality cannot be ignored, no one at this late day would be so foolish as to deny that the automatic piano player has performed the useful service of musically educating a great public which ordinarily would confine itself to the street song of the moment. The effect of the player piano is already apparent in a larger attendance at concerts—an effect which was probably far from the minds of the men who originally conceived the idea of causing the hammers of a piano to work by means of a perforated paper roll and pneumatic mechanism.

After the problem of providing machinery for playing the piano automatically was solved, it was but natural that an attempt should be made to play other musical instruments mechanically. As a key-board instrument, the problem offered by the piano was comparatively easy of solution. Stringed instruments of the violin class offered obstacles which at first sight it would seem almost hopeless to overcome. First of all, there is the difficulty that the finger must form its own notes, and not simply play upon a visible key in a definite place, as in a piano. Then there is the obstacle presented by the bow; for the tone must be produced by drawing the bow across the strings in a particular manner to produce a particular effect. Because it is entirely free from all tone-producing mechanism, apart from strings and a bow, the violin long defied the efforts of the inventor to play it mechanically.

A violin player, which represents the combined ingenuity of Johann Bajde, Gustav Karl Hennig, Ernst Alford Hennig, Robert Froemsdorf, and Ludwig Hupfeld, has recently made its appearance, which reproduces with remarkable fidelity the performance of a great violin virtuoso. In the automatic piano player, it is merely necessary to provide some way of depressing the keys, so that the hammers shall strike the strings in the proper way. Hence the mechanism of the piano player follows the methods of hand playing with fair accuracy. In the mechanical violin in question it has been found necessary to depart from the method employed in hand violin playing, in order to obtain the proper effect.

The chief difficulty which is necessarily encountered in constructing a violin is the method of producing the tone. The violinist uses a straight bow composed of numerous horse hairs. The quality and volume of the tone which he produces depend upon the speed of the bow's motion across the string, and its pressure on the string. Obviously, to reproduce the movements of a loose wrist and straight bow would be a monumental task for any inventor. Then there is the added difficulty of moving the straight bow so that it will play upon a single string or upon two strings.

The inventors of the mechanical violin illustrated have in the first place, abandoned the idea of playing a single violin with four strings. Instead, they have adopted three violins, each provided with but a single string. The individual *a*, *d*, and *e* strings of these instruments perform all the musical functions of the usual four strings of a single violin.

These three violins are played upon by a circular bow composed of three thousand horsehairs. The bow completely surrounds the violins and is in continuous movement. In order to produce a tone, the particular violin required is bodily pressed against the bow with more or less force, thus reversing the method of hand playing. The speed of the bow's movement is modified to produce the particular kind of tone and quality desired.

The actual notes are formed by fingers on the neck of the violin, which fingers are operated by pneumatic mechanism controlled by the usual paper roll. By moving the violins toward and from the bow and by varying the speed of the bow's movement, the tone produced can be varied from the finest pianissimo to a powerful forte. The actual formation of the notes obviously offers fewer mechanical difficulties than those of bowing and shading. Mechanical fingers are provided, which play upon the neck of each violin in response to the perforations of the paper roll as it passes over the usual pneumatic tubes. The vibrato or tremolo which gives to violin playing its human quality is obtained, not as the living artist obtains it, by means of the finger on the neck of the violin, but by vibrating the string at the base of the violin. The musical result is the same.

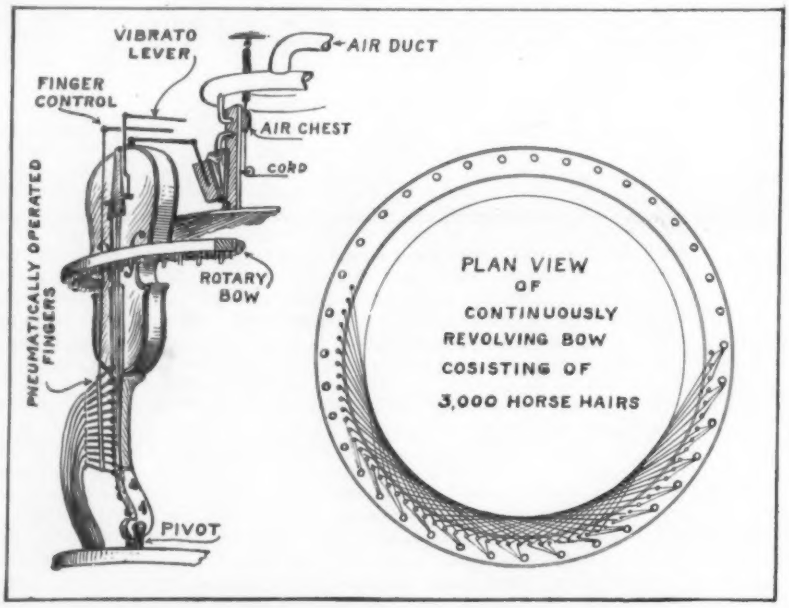
The only effect which cannot be obtained on the instrument is that of the glissando; in other words, that rapid sliding of the finger along a string which produces the characteristic moaning of a violin in legatissimo playing. Still, the lack of the glissando is hardly noticeable. In the first place, the glissando is used by the great violinists sparingly, and in the instrument itself a perfect legato is obtained, which is an excellent substitute for it.

As it stands, the instrument may well be said to reproduce the works of the great composers for the violin with all the artistic finish that can be desired. Moreover, the mechanism has an advantage over the virtuoso, because its intonation is always faultless. No selection moreover is too complex. Paganini's "Moto Perpetuo" is executed with the same ease as a simple ballad.

The circular bow must be rubbed with rosin occasionally, in order that the horsehairs may bite the string. In this mechanical instrument it is simply necessary to depress a button whereupon a piece of rosin is mechanically pressed against the bow.

Tuning, however, is effected by hand, as in the ordinary way. In other words, a tuning peg is turned and the string brought to the proper tension by ear.

Combined with the mechanical violin is an automatic piano player. This instrument, however, is intended not only to use the ordinary perforated piano roll, but also rolls which reproduce the playing of great artists. Famous virtuosi, such as Busoni, Hofmann, Reisenauer, Gruenfeld, Teresa Carreño, and others, play upon an ordinary grand piano, and, by means of special mechanism, a continuous record is obtained, upon which are noted tempi, fortes, pianissimi, legati, pedaling, and the like. By means of this "indicator card," a roll is perforated, which reproduces the artist's playing exactly. The virtuosi rolls play the piano mechanism without in any way influencing the violin mechanism. So, too, the violin mechanism, when it plays such unaccompanied pieces as Bach's Chaconne, does not in any way affect the piano mechanism. Since most violin selections usually require an accompaniment of some kind, both the piano and violin are usually played simultaneously, but only one perforated roll is used to control the interpretation of both instruments.



How the circular bow plays the three single-stringed violins.

AN AUTOMATIC VIOLIN AND PIANO WHICH PLAY TOGETHER WITH REMARKABLE HUMAN EFFECT

Motor Sledding at Saranac Lake

THE charm of great speed is one that appeals to almost every one, and many a man would delight in a racing automobile were it not for the danger and expense; but the motor ice sled offers terrific speed along with perfect safety and at a comparatively slight drain on the purse. In fact, if one has an automobile from which the engine may be used, the expense can be kept very low indeed. But do not think that rushing up and down a 10-mile lake at full speed is the only fun that may be derived from one of these machines. To run up a lake towing a toboggan or two and have a winter picnic on the shore of some island is to live a real day; or to glide lazily in and out among the throngs of skaters with a machine that obeys the slightest touch on the throttle or wheel, is such a simple but yet pleasing experience that the automobile seems forever after dull.

The first experiment in motor ice boating at Saranac Lake was made in the winter of 1909 by H. Webb Hyde of Boston. He installed a six-horse-power engine in the hull of an old experimental hydroplane, and with a propeller roughly hewn from a single stick, he obtained a speed of thirty miles per hour. The following winter, J. Benson Marvin, Jr., of Louisville and Charles S. Palmer of New York, joined forces with Mr. Hyde. They increased the horse-power to ten and constructed a more efficient fan with which a speed of forty-five miles per hour was obtained. Last year they built a sled entirely of iron and equipped with a thirty-horse-power, six-cylinder, air-cooled engine. The only official time trial of the machine was run on ice covered with a coating of snow. But despite this handicap a three-quarter mile straight course was made in 29 seconds, or 91 miles per hour. This winter, the ice boat has been somewhat remodelled, a four-cylinder water-cooled engine of about forty-five horsepower having been installed. As yet, there has been no good ice for running.

The early sled, built from the hydroplane hull, is called the "Amphibia," for with its boat-like body, it is equally at home in the water and on the ice. The large one incurred the name of "Blasphemia" during the progress of forging the front runners. There are two sets of runners—the main sled forward, which carries one thousand of the twelve hundred pounds total weight—and a pair of steering runners in the rear. The bob was originally built with but a single runner in the rear, but with this construction, the control was so uncertain that two runners were afterward adopted. The front sled is made of 2 by 3-inch angle iron, and it is the edge of the 3-inch side that runs on the ice. The bearing surface is 7 feet long and the tread 5 feet. The runners are joined by arches of the same material. On the crown of these arches are bolted four sets of semi-elliptic springs, and these support the main frame. The rear runners are 2 feet long, cut from 5 by ⅝-inch bar iron. They are bolted through the center to rods of 1½ inches diameter that run up through the frame, and above the frame are bent toward each other to form tillers. These tillers are connected by flexible bronze rope to the drum on the steering wheel. The toes of the runners are linked together by a cross bar of gas pipe so that they must always remain parallel. Each of the steering rods runs through a coil spring and these springs carry the rear weight of the sled, or about two hundred pounds. The omission of springs is the greatest error that the novice usually makes; for high speed is impossible in an absolutely rigid frame, and even the smoothest ice has some bumps. The main frame is made of 3-inch channel iron hot-riveted together. It is 23 feet long and 26 inches wide and has suitable trussing.

The engine is placed centrally over the forward sled and is tipped at an angle of four degrees. It is connected to the shaft by a universal joint which allows three degrees more; so that the driving shaft has an angle of inclination of seven degrees to the horizontal. This inclination raises the rear end of the shaft sufficiently to allow clearance for an eight-foot propeller. Inclining the shaft in this manner is not only simpler, but is much more efficient than driving the propeller with a chain from a horizontal shaft.

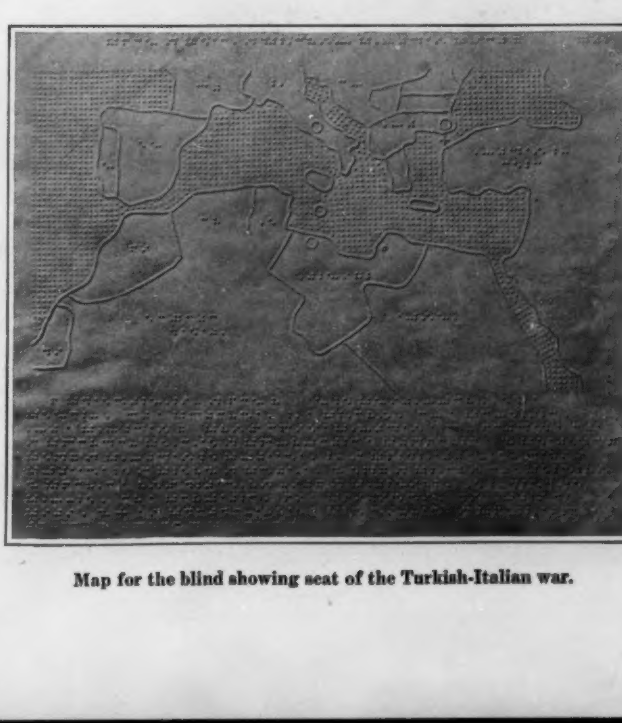
A number of propellers are always kept on hand. They are of various sizes and shapes, from a thin slender stick of wood 7 feet long with very small blade area, but with a pitch designed to give 120 miles per hour, to a propeller 8 feet long with blades 18 inches wide, giving them a tremendous area and a very strong thrust, but having a pitch designed to give 30 miles per hour. This propeller is used when running the ice boat out to the lake.

Besides the propellers, it is also necessary to have an additional set of runners, as the thin ice runners would be entirely unsuitable for traveling over snow-covered roads.

The "Blasphemia" has done 91 miles per hour on snow-covered ice.

The "Amphibia," equally at home on water and on ice.

Double plates for the interlining system of printing.



Map for the blind showing seat of the Turkish-Italian war.

Interlined Printing for the Blind

By Walter G. Holmes

WHEN printing for the blind was first introduced a raised Roman letter was used; but years ago it was found that a system of points could be more easily distinguished than those letters, and now practically all printing for the blind is done in the point system. It has the advantage that stereotype plates can be made without having to set up type.

The plates are made on machines controlled by a keyboard. When the operator strikes certain combinations of these keys, the point characters representing the letters, are made directly on brass or zinc plates.

One of these brass plates is placed on a cylinder press and against it on the opposite cylinder is a rubber blanket. As the moist paper is fed between this rubber and plate, the impression is made upon the paper, and when it dries it is hardened so that it does not rub down under the touch of the finger in reading. By this process, however, only one side of the paper can be utilized.

For some time interlining or interpointing has been done by means of double plates by which both sides of the paper could be used, but this process was so very slow that it was largely impractical. The British and Foreign Blind Association in London has done interlining or interpointing by means of a platen press, but the Ziegler Publishing Company for the Blind of New York, publisher of the *Matilda Ziegler Magazine for the Blind*, has lately devised a plan by which the principle can be applied to the rotary press, and it is possible to do interlined printing at the rate of over 25,000 pages an hour.

For this purpose double brass plates are made. A double sheet of brass is placed in the plate-making machine and the lines are made in the regular way on one side of this double plate, but the points are made to go through both plates. After the lines of points are made on one side, the double plate is reversed and the lines of points are made on the other side between the lines that have been previously made on the other side of the plate, so that on each side of each plate there is a row of points alternating with a row of holes which make the points on the reverse side. Each point, therefore, on each plate has a corresponding hole into which it fits into the other plate. It will be readily seen that if a sheet of paper is put between these two plates and they are pressed together, an impression will be made on both sides of the paper.

Now, to apply this to the rotary press, the Ziegler Publishing Company has had the cylinders of its press so registered that if one of these double plates is placed on one cylinder and the other on the opposite cylinder, they will fit as the two cylinders revolve together, and each point on the one plate will strike directly into the corresponding hole on the other plate and *vice versa*. The moist paper is fed between these plates and the rubber is done away with. It is found that in this way a more perfect and uniform print can be secured than heretofore.

By this process 50 to 75 per cent more matter is obtained on each sheet of paper, which means almost a revolution in printing for the blind, for not only is the paper expensive, but matter for the blind spreads out so that under the old process books were of necessity very bulky. The first issue of the magazine to contain the new printing was that of October last. Sixteen pages were interlined, and the readers were not only greatly delighted with getting more reading matter in their magazine, but they found that it was just as easy to read as before.

The Turret Telescope

A New Form of Mounting Adapted to the Comfort of the Observer

By Prof. S. A. Mitchell, Columbia University

THE lot of a professional astronomer is no easy one. Several years ago, while at the Yerkes Observatory of the University of Chicago, the writer had abundant opportunity to learn what hardships it is sometimes necessary to endure in order to get astronomical observations. Many nights during the month of February in a winter spent there, the thermometer was below zero; and on one particular night, while Prof. Barnard was working with the 40-inch, and the writer with the 12-inch, the thermometer dropped as low as 26 degrees below zero, Fahrenheit! And on this night, each of us worked for more than twelve hours! About three o'clock in the morning, work was interrupted by a sudden snow squall coming from a clear sky. This was caused by the freezing of the moisture in a passing cloud; and when this passed, the sky was brilliantly clear till morning. It is probably needless to add that the coming of the dawn was watched with a great deal of rejoicing. And though it is more than ten years since that night, the impression of it is as vivid as ever.

Those not familiar with the workings of an observatory will ask why it is not possible to keep warm by heating the building. Those who have ever seen the average observatory do not ask such a question, for they realize that the telescope is placed under a dome capable of rotating, with an opening or slit in the roof through which the telescope looks out to the sky. If the dome were heated how long would this heat remain when the slit in the dome was opened? And while the heated air was rushing out, the air in front of the telescope lens would be in violent commotion, and the "seeing" would be very bad. Ordinarily, the seeing is better when the temperature within and without the dome is the same. So that if it is a cold night in winter, there is no way for the astronomer to be comfortable, he must work in the cold—and be cold. And it is unfortunate, too, for the astronomer's work that the long nights come in the chilly winter, while the short ones come in the comfortable summer.

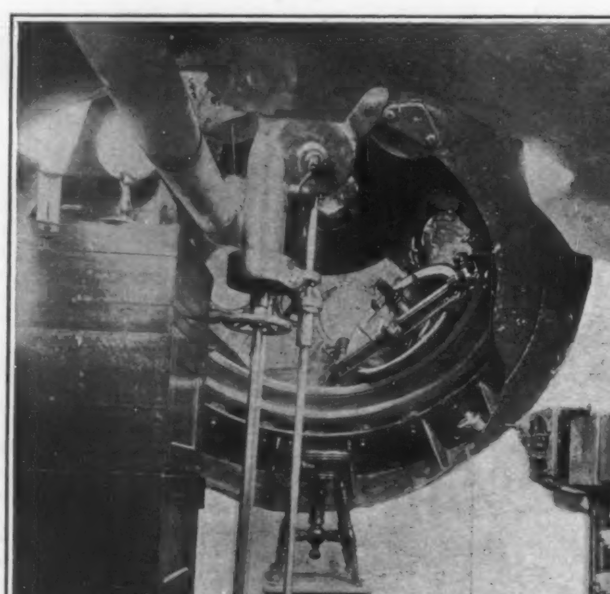
One must have a great love for astronomy and be gifted with wonderful enthusiasm to make a successful observer, for the disappointments of bad weather and poor seeing, and the rigors of the winter weather would deter any but the most ardent. If one is a professional astronomer, he puts up with the bodily tortures it is necessary to endure, for he has sufficient enthusiasm for his work. If one is an amateur, the enthusiasm of the beginner soon dwindles away, when it is discovered that it is necessary to be uncomfortable in order to gain a knowledge of astronomy.

It would be a great boon to both professional and amateur, if the mounting of the telescope could be so changed that the observer could be left in comfort in a warmer room. The standard form of erecting the telescope, known as the "equatorial" mounting, is placed ordinarily under a semi-circular dome, the equatorial form being necessary in order to be able to neutralize the rotation of the earth by a motion of the telescope about its polar axis. This standard form has come to its greatest completeness in the Lick and Yerkes telescopes designed by Warner and Swazey of Cleveland.

Many attempts have been made to keep the observer in a heated room, the most famous of which has been the *equatorial coudé*, or elbow-telescope of the Paris Observatory. With this form, two extra reflections from plane mirrors are necessary. These mirrors, which must be much larger than the objective, add greatly to the expense of the telescope, and largely decrease its optical efficiency. The well-known excellent photographs of the moon taken at Paris with this instrument are abundant proof that there are no serious drawbacks to this form of mounting. While measuring with such an instrument, the observer sits in a comfortable position in a heated room, and looks in a fixed direction down the polar axis of the telescope. All observers know that their own measurers are most accurate when they are most comfortable, so that the quality of the work as well as the quantity would be improved if the astronomer could be kept in a heated room.

A tunnel 240 feet long connects the observatory to the house.

The novel turret-mounting as viewed from outside.



Interior of the observatory. Note the eyepiece at the right.

Undoubtedly, the most promising form of all mountings which keep the observer housed is the "turret telescope" of Mr. James Hartness, of Springfield, Vt. Mr. Hartness, though making no pretensions to being an astronomer, is the efficient president of the Jones and Lamson Machine Company. The mounting was entirely designed by him, and most of the work done in his own shop in Springfield. At the invitation of the inventor, the writer went to Springfield and saw the instrument, and can speak in the highest terms of it.

In this new instrument, the objective has the diameter of ten inches, one additional reflection only is necessary, introduced by a diagonal prism near the eye end. All optical parts are by Brashear.

Of polar axis there is none, its purpose being accomplished by a turret revolving in the plane of the equator. To the turret is fixed the declination axis about which the telescope revolves, and where the declination axis cuts the optical axis of the telescope there is located a totally reflecting prism turning the beam through 90 degrees. The observer sits in a comfortable position facing toward the north, and is obliged to change his position very slightly as the telescope follows the object. He may see what the weather is like by looking out through several windows in the turret near his head. There is no dome to shelter the objective, in fact, this is left free in the open air. The average professional astronomer would look askance at leaving a valuable objective unprotected from the elements other than by a cap. The cap on the telescope of Mr. Hartness fits very snugly, and though the objective had not been touched for two months before the time the writer saw it, there was hardly a trace of dust to be seen.

From Mr. Hartness' house, the observatory is approached through a tunnel 240 feet in length, and 9 feet high, the telescope being on the brow of a hill. The first room entered is a comfortable office. Through a door and up a few steps, one is in the observatory. Up a few more steps, and one seats himself at the eye end of the telescope. A circular ring about the eye-piece is the graduated declination circle of 24 inches diameter, and on this by means of a convenient handle is readily turned off the declination. Around the edge of the turret inside is the hour circle of 48 inches in diameter. This ring of four inches wide and three-fourths inch thick may be moved by hand and set to the right ascension of the star to be observed. The whole turret is now turned in right ascension by means of an electric motor, and when the sidereal time is set off, the quick motion is shut off and a slow motion substituted in order to drive the telescope. The writer set on several stars with the greatest of ease.

Regarding the mechanical precision of this form of telescope, one very naturally asks about the reliability of the turret to maintain the plane of the equator, and permit of rotation in this plane. These features are accomplished by providing the turret with a perfectly planed surface on its under side, and a truly circular track. It also requires in the building a stable mounting for rolls on which the turret rests. In fact, there are two sets of rolls; one set on which the flat face of the turret rests keeps it constant in direction while the circular part of the turret bears on the other set of rolls, and upon motion being imparted to these by the electric motor the telescope is revolved. It seems to the writer that the excellent precision of modern machine-shop work will insure for this form of telescope all the accuracy necessary.

This instrument is decidedly superior in optical efficiency to any Condé form of mounting, or any horizontal or other form of telescope fed by a coleostat or siderostat. In fact, is practically as efficient as the standard equatorial with a diagonal eye-piece, for this new telescope might be briefly described as a mounting in which the telescope revolves about its diagonal eyepiece. Consequently, it seems that no objection can be

(Concluded on page 225.)

Curiosities of Science and Invention

READERS are invited to contribute to this department photographs of novel and curious objects, unique occurrences, and ingenious contrivances. Such as are available will be paid for promptly.

Protecting the Ears from the Shock of Gun Fire

A DARING photographer on board a battleship recently tried to take a photograph of a salvo of 12-inch guns while standing on the forward bridge. The impact of the air waves produced by the discharge threw him on his back and wrecked his camera, but the photograph was saved. We published it in our issue of December 9th, 1911. Many of our readers may have wondered how the men on deck can stand the awful shock produced by the discharge of heavy artillery. Of course the gunners within the turret are not affected much because the gun discharges outside. To save the ear drums from destruction ear-protectors are employed, such as shown in the accompanying photograph. The protector consists of a celluloid piece shaped somewhat like an anchor with a ball at one end, which fits in the ear opening. The device is formed with a bore which turns at an angle at the ball, and it is through this bore that sound waves are permitted to travel to the ear. The ordinary vibrations produced in speech are so small that they pass unhampered through the bore, but the large sound waves produced by the firing of big guns are impeded.

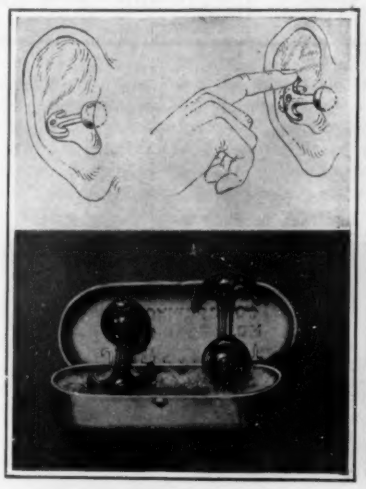
Some Novel Electrically-driven Clocks

TWO very interesting clocks have recently been devised in Brighton, England. One of these employs a heavy balance wheel electrically operated on a somewhat similar principle to the pendulum in electric clocks. However, the balance wheel drives the wheel train, instead of being driven by it.

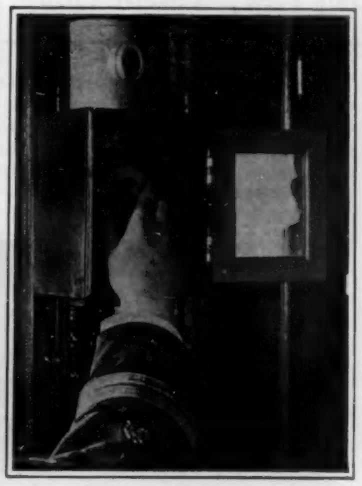
As soon as the arc of oscillation falls to a certain fixed minimum, the electric circuit is automatically closed and fresh energy is imparted to the balance wheel, by the action of an electro-magnet and armature, sufficient to keep it vibrating for an interval of about two minutes—more or less—according to the condition and strength of the battery. The time-keeping is practically independent of variation in battery power. A regulator arm is provided which operates on the giant controlling hairspring exactly as in a watch. By means of a roller attached to the upper part of the staff a lever is made to operate the wheel train at every oscillation of the balance wheel.

In the self-contained electric pendulum clock the wheel train is extremely simple.

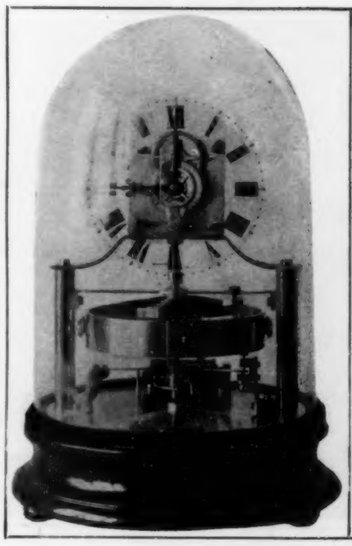
The "crutch," which is the forked rod by means of which the pendulum's motion is communicated to the wheel-work, is pivoted in a bracket at its upper end, and a little lower down carries a projecting arm on which are carried the pallets that engage the escape-wheel. The fork in which the pendulum rod hangs is near the lower end of the crutch, while hanging quite freely from the extremity of the crutch is a small piece of steel known as the "toggle." This, as the pendulum swings, slides over and off a brass block attached to a long flat spring, one end of which is fixed in a stud; the free end is faced with platinum and plays between a platinum tipped contact screw and a limiting screw above it. Normally the spring presses upward against the point of the limiting screw, but when the pendulum arc is not sufficient to insure that the "toggle" will sweep off the block, the point of the "toggle" trips in a groove on the block, thus depressing the contact spring, by which the circuit is completed and the electro-magnet energized. This occurs as the armature on the lower end of the pendulum is approaching the magnet, and the attraction on the armature imparts a fresh impulse to the pendulum.



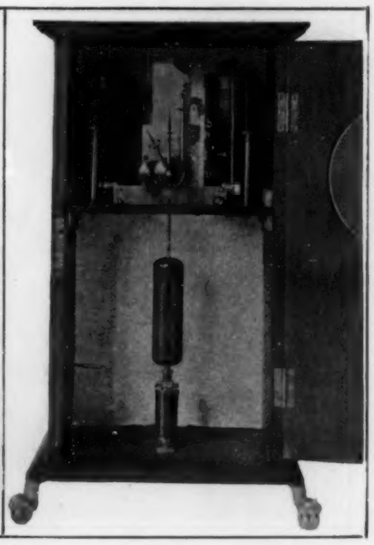
Ear protectors used by the personnel of the navy.



Releasing the automatic life rings from the bridge.



Balance wheel electric clock.



Self-contained pendulum electric clock.

A hydro-aeroplane capsized by alighting on a rough sea.

"One-piece" flowers hammered out of soft steel.

Automatically Tripped Life Rings

THERE is perhaps no means of transportation in which so much is required in the way of safeguarding the lives of those intrusted to it, and which has to be equipped with so many and various appliances for the achievement of this end, as the modern passenger ship. In a bad storm a sailor and even a passenger may be washed overboard, or a passenger or fireman, temporarily deranged, may leap overboard into the sea. To provide for an emergency of this kind, one or more boats are always kept so that they can be launched at a moment's notice, as considerable time would be lost if the tarpaulin coverings had to be removed as with the regular lifeboat. A safety device, which has given excellent satisfaction, is a device for releasing life rings fore and aft, both on the port and starboard side of the vessel. As soon as the news of "man overboard" reaches the bridge, either by the "wig-wag" or the ship's telephone, the officer on duty gives one turn of a valve and the life rings are automatically released. After they have all reached the water a red electric light flashes up at the top of the apparatus, showing that the mechanism has performed its duty.

Diving With a Hydro-aeroplane

HUGH ROBINSON, who has been giving a series of flights on the Mediterranean at Antibes, France, with a Curtiss hydro-aeroplane, had a slight accident on Saturday, February 10th, but was not injured, although his machine was badly smashed.

Robinson made a daring attempt to alight upon an extremely rough sea while flying with the wind. Against the protests of a number of French officers present he went aloft in a 35-mile gale and flew successfully 20 minutes, quite astonishing the Frenchmen, who believed that only their fast monoplanes could fly without mishap in such weather. When about to alight Robinson was traveling with the wind at terrific speed. Instead of turning and heading into the wind, he alighted while going with it; the following wind lifting the tail of his craft and capsizing it. He was thrown into the sea, but was immediately picked up by a motor boat. The planes of the hydro-aeroplane were smashed, but the motor was not damaged. The hydro-aeroplane did not sink, but several days' work was required to repair it. The machine did not turn a somersault in the air, as has been stated.

Wrought Metal Flowers

PICTURED herewith are two flowers hammered out of soft steel. The rose was made of a single piece of metal to which the bud (also made from a single piece) and leaves were added by welding. The bell of the lily blossom was made without welding but the pistils are separate pins riveted in place. In the making of a rose a piece of steel about one-half inch in diameter is used. This is hammered down to form a stem with a cylindrical knob at one end. The knob is split to form the leaves of the blossom and they are worked individually and shaped to imitate nature. It will be noticed that each leaf has an individuality all its own and that they overlap one another very artistically in a manner which is a considerable improvement on work as done heretofore. Iron roses are often made of separate sheets of metal riveted together, but such work is apt to work loose owing to the difficulty of riveting the parts. The samples of "one-piece" flowers we illustrate were made by Mr. Ernst Schwarzkopf, who is conducting a class in manual training at the Stuyvesant High School, New York. The students of the Stuyvesant High School have taken to the work with eagerness and are turning out very creditable examples.

What Inventors Are Doing

Simple Patent Law; Patent Office News; Inventions New and Interesting

A New Process for Electro-plating Metals, Ceramic Ware, Wood, and Other Substances

By the English Correspondent of the Scientific American

WIDESPREAD interest has been aroused by the perfection of the ingenious process that has been evolved by two Italian chemists, the Brothers Marino, whereby metals and metallic alloys can be deposited on other metals, ceramic ware, wood, celluloid and other substances by electric agency.

So far as the fine arts are concerned the process is superior to the ordinary silver plating methods. The base is covered with a thicker deposit of the metallic covering, which becomes associated with the metal beneath, forming an integral part thereof. The thickness of the coating can be varied as required, according to the period of immersing the article in the bath. This enables the article to be engraved after being plated. The fact that the outer sheathing is a solid silver is borne out by the fact that the British authorities have expressed their readiness to hall-mark subjects so treated.

Glass and chinaware are not silver-mounted by attaching the mounting by the aid of plaster of Paris, but the metal is applied directly upon the surface of the glass. It cannot be scratched or chipped off without chipping or breaking the glass.

Primarily the surfaces of many objects to be treated must be rendered electrically conductive. China and glass, for example, are non-conductors. The previous methods adopted to achieve this end have been somewhat involved, and the metal unless burned in, is merely attached to the surface of the article by an adhesive. In the Marino process the surface to be treated is rendered conductive by a chemical reaction, which, however, does not necessitate recourse to the application of heat. For instance, if glass is to be metallically mounted the surface to be treated is first subjected to sand blasting, to remove the polish and to provide a rough face to give the metal a grip. This abrased part is then chemically treated, so that when the article is suspended in the electro-plating bath, the metal, whether it be gold, silver, or any other metal or its alloy, is attached and forms an integral part of the foundation. Glazed china cannot be plated as the glaze prevents the metal entering into the composition of the ware. One of the illustrations shows a Wedgwood tea service which has been plated externally. The outside appearance conveys the impression that the articles are wrought in silver or are electro-plated, which impression is intensified by the metallic ring which the articles emit when tapped and from their weights. Internal inspection, however, reveals the pottery foundation.

The outer metallic sheathing, if carried to a sufficient thickness, performs another important object. It protects the article against damage. It may be dropped or knocked but it will not break. The china base may crack but the metallic coating will preserve it intact. The articles so treated when withdrawn from the electro-plating bath have a dull appearance but a brilliant luster and polish is imparted by the usual means.

The process deposits in a perfect manner such difficult alloys as silver and nickel. The alloy Marino uses for this purpose comprises 10 per cent of silver and 90 per cent of nickel, though these proportions may be varied. This alloy, however, gives a hard, untarnishing, durable, white metallic surface similar to Britannia metal. Alloys of silver and tin, and of silver and cadmium, can be deposited just as easily and as efficiently. The perfection of this operation is of far-reaching importance to the manufacture of cheap cutlery and similar articles, inasmuch as they retain their original appearance and luster indefinitely, comparing favorably with silverware in appearance

A silver-plated Wedgwood ceramic tea set.

Plating china with gold and silver.

Galvanizing china by electro-deposition.

and with nickel in wearing qualities, while the cost is only approximately the same as nickel plating.

In regard to the more general industrial applications the process is equally useful and revolutionary. This applies especially to the electro deposition of tin, lead, zinc and other alloys on steel, iron, etc.

The Patent Office in the Good Old Days

By an Old Examiner

I ENTERED the Patent Office in 1865, as a clerk, at the royal salary of $97.50 a month. According to the custom of the time, I was admitted without examination, as a clerk of low grade. An humble clerk was not required to know much. By the edict of the Commissioner, who, I suppose, was otherwise satisfied as to my qualifications, I was assigned to duty as an acting Assistant Examiner. At that time the Patent Office was run without appropriations. The expenses were paid out of the receipts. Great economy, therefore, was practised, and this was more cheerfully done in the matter of salaries than in the other expenses, so that if a man could be found who was willing to serve as an Assistant Examiner, with a fair prospect of competent service, on the salary of a clerk, it was considered a stroke of high finance. There were criticisms as to the other expenses, but only grumbling in the matter of salaries.

I had the honor to be conducted to the room where I was to work, and to be introduced to the Examiner, by the Commissioner in person. This was my first personally conducted tour; except once when we went into battle with a brass band. That there was any record of my access to the Patent Office, other than the entry of my name on the pay roll, I am unable to say. I know only that I was thus introduced to the Examiner, a dignified elderly man with an ample red nose, and by him was assigned to a desk and to my duties.

Instructions in those duties were scant. The personnel of the class consisted of the Principal Examiner, a somewhat rusty first Assistant, and myself.

The conditions differed materially from any that I had ever before experienced or observed, notably from those of the camp in the field. An atmosphere of perfect calm pervaded the room. Business was not advertised for and apparently not acutely desired, but was received as an unavoidable incident of the situation. Each day's assignment of applications was allotted by the Examiner, who with becoming modesty reserved the smallest part for himself. He had in addition, general supervision of the work, and in particular the survey of that part of the city visible from the windows. I found my duties to include, among other things, the clerical work of keeping the books and taking care of the papers. When that was done I examined applications. That left me little time for the study of the law and of the rules pertaining to examinations. Examiners' clerks had not then been invented.

An elderly and very deliberate boy came around occasionly and collected from the various Examiners' rooms, the rough drafts of letters written by the examining corps. These were taken to an upper room where they were deciphered and copied by a corps of decayed gentlemen whose lack of nerve and muscle had kept them out of the ranks of the army during the war.

This was long before the reign of the Civil Service Commission and in the days when "influence" prevailed. In the examining corps were two ex-Governors of States, venerable and dignified men, as well as an ex-newspaper reporter. Indeed, almost every man in the corps, in or past middle life, was an ex-something, these exes having apparently been the stepping stones to the Patent Office. The examinations for admittance to the corps were called "pass" examinations, and indeed were rightly named. The candidate was decided upon by the Commissioner and then "passed" by the examining board.

Such being the conditions it followed that there was not any surplus of mechanical knowledge in the Office, that it existed in spots and was largely of subsequent acquisition. Not much more can be said of legal knowledge. There was one new Examiner who probably had abandoned his office in a country town for the double reason that he had nothing to do and did not know how to do it. He was hearing a case involving questions of mixed law and fact. At the outset he said to the attorney, "I do not know anything about mechanics, but if there is any law point in the case I would like to hear you on that."

There were some remarkable theories from the legal point of view. For years it was the practice to reject new applications on other applications which had been abandoned; and it required a decision of the Supreme Court to inform the Patent Office that an abandoned file of papers was not a bar to the issue of a patent for an invention.

In the inception of the typewriting machines, a typewritten application appeared in one class. This was a startling innovation and, being new, must be wrong. The alarmed Examiner put on his glasses and read the law, perhaps for the first time. He there read that

the application must be made in writing. "This is not writing," he said, "it is print," and straightway he rejected the case.

To the same Examiner, at another time, came an application for reissue of a patent, then recently allowed by him. The papers were in due form and complete, including the return of the patent. The attorney, not hearing from the application, made personal inquiry. The Examiner advised the attorney that he had received the application, with the patent, and that he was very glad to get it. He had made a mistake in allowing that patent, and now that he had his hands upon it, intended to keep it.

The methods and resources in the Patent Office, during the years immediately following the civil war, were imperfect and crude. There were no copies of specifications of patents, except those in the original files, or those transcribed into the record books; and no copy of the drawing, except the copy originally filed by the applicant. No rigid rule of dimensions or style was observed. The drawings were usually very large. They were kept in huge stiff portfolios, shoved into place on rollers, and examined with great difficulty. In his examination of a case, an Examiner was obliged to read the specification, then go to the draftsman's room, and sitting on a stool, with the portfolio resting on the floor, bent over and uncomfortable, to compare his more or less imperfect recollection of the invention with what he found in these drawings. Whatever struck him as worthy of further inspection, he took to his room, so that the record of the draftsman's room was never complete.

The drawings were in a state of perpetual flux and reflux. The only recourse an attorney had, beyond the meagre information of the Patent Office Reports (never up-to-date) was by ordering the drawing, cited as reference, to the attorneys' room.

For preliminary examination, he had next to nothing. The Examiners consulted frequently with each other, and more frequently with the Librarian, who, at that time, was a learned man, active and with a vast fund of general information. He frequently went around to the rooms of the Examiners distributing knowledge in particular cases, easy for him to do, as the new applications generally lay on the Examiner's table, awaiting action. If he happened to notice one or more for which he thought he could find a reference, that case was laid aside. As these references were slow to realize, if ever, he would have a large percentage of the cases tied up, awaiting this auxiliary action.

These things are not fables, but they serve to illustrate the advance made in the Patent Office since the days of Commissioner Fisher, who was the first to take the Patent Office out of the ruts and give it new life. To him, perhaps more than to any other, is to be credited the present high condition of the Patent Office.

New Electrical Uses for Aluminium

THE first extensive use of aluminium wire for electrical purposes was made at Niagara Falls where it was utilized for the cables by which the heavy voltages are transmitted from one point to another. The copper wires ordinarily used for this was found to be entirely too heavy and the problem for a time confronting the engineers was that of designing poles which would not only hold the wires but the heavy crust of ice which is frequently deposited on them during the winter. After this the favorable properties of aluminium were as a substitute for copper more eagerly taken advantage of by the engineers of Europe than those in this country. In France and England there are to-day hundreds of railway motors in service which are equipped with aluminium field cores. The use of this material in this connection has a double advantage. First of all it is light and then again, an equally important consideration, a natural oxide is formed on the metal which absolutely prevents electrical leakage.

The entrance of water into the windings of such magnets of the older type was always disastrous, but with the aluminium the presence of water does not in the least impair its qualities but actually improves conditions in that it heightens the coating so that as they grow older, the magnets are rendered more and more proof against the action of water.

It is only lately that this discovery has been availed of by American manufacturers and lifting magnets are soon to be placed on the market made on this principle and it is said that these can be constructed with one-third the weight and the same number of amp-turns and equal carrying capacity as the copper wound magnets.

It is said to be possible to deepen this oxidization so that no other insulation is necessary. Aluminium is one-fourth as heavy as copper and has a specific resistivity of not quite three times as great.

Combined Alarm and Indicator System

A PATENT has recently been granted on a combined fire alarm, burglar alarm and annunciator system, which is suitable for use in connection with a number of rooms and a single office common to all of these rooms. Each room is provided with a push button for sounding a call bell in the office, or for communication with other parts of the premises; and each room is also provided with means separately controllable for automatically energizing, through the same conductors, an alarm in the office. The costs of manufacture, installation, and upkeep are less than the combined costs of any two separate systems and while neither system interferes with the operation of the other, any condition that will render one inoperative will also render the other inoperative. This is of great advantage, especially with regard to the fire alarm, for as this is seldom brought into service it might be out of order for long periods without being discovered under the ordinary local fire alarm practice, whereas under the above conditions anything which would render the fire alarm inoperative would be discovered upon the failure of the call bell or telephone.

Notes for Inventors

The Esquimau as an Inventor.—A collection of Esquimau inventions, now on exhibition at the Affiliated Colleges, San Francisco, substantiates the claim that the Esquimau is the most able inventor and skilled engineer among uncivilized people. In support of this, the collection includes, the first form of the oil heater and cook stove, water-tight boat, arch, used for building purposes, and waterproof overcoats, as well as the most perfect types ever developed of the fish spear, spear thrower and harpoon. The smoking pipes form a link with Asia, and their carvings with prehistoric Europe.

Foot Warmer for Automobiles.—A foot warmer, patented by E. M. Field, Jr., Minneapolis, Minn., has been applied to many automobiles. In applying the invention to an automobile employing a water cooled engine, the heat transmitted from the engine by the cooling water is utilized, so that the foot warmer is caused to serve both as a heat radiator for the feet and a cooling coil. If the engine is air cooled the hot exhaust products of combustion from the engine are utilized. If the automobile is driven by a steam engine the exhaust steam is transmitted through the foot warmer. To carry out these ideas circulating pipes extend to and from the engine.

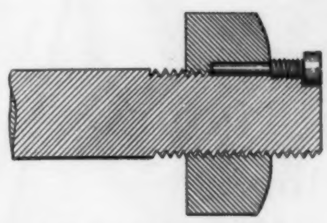
Wright Patents in Germany.—According to press dispatches, the Wright patents on flying machines, covering the simultaneous action of wing flexing and rudder movement have been declared void. Whether or not this express opinion is justified by the actual decision itself we cannot, of course, state at the present time.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Hardware and Tools.

LOCK NUT.—L. BECK, Kirkland, New Mex. In this patent the invention provides a form of lock nut so constructed that the same is positively locked in position and securely and efficiently held in place, and which, at the same time, may readily be detached when desired to remove the nut from the bolt. Mr. Beck attains the above object by providing a semi-cylindrical groove extending longitudinally in the threaded portion of the bolt, and by providing a similiar groove in the threaded portion of the nut, tapping out the aligned grooves, into which tapped-out portion may be inserted a threaded key to hold the bolt and nut in position. The invention is shown by the accompanying engraving in a longitudinal sectional view taken through the bolt and nut.



SECTIONAL VIEW OF LOCK NUT.

Heating and Lighting.

SUCCESSFUL BRIQUETTING OF NORTHWESTERN COALS.—The United Collieries Company of Seattle, Wash., owners of the largest briquetting plant on the Pacific coast, report having made a success commercially of briquetting Northwestern coals, both lignite and bituminous, in the face of repeated failures on the part of others who have attempted to accomplish this feat; and they attribute their success both to the remarkable binder worked out and recently patented by W. W. Langdon of Walla Walla, Wash., from whom the right to use this process was obtained for their plant in Seattle, and also to the unique and original methods and machinery perfected by them for the handling and briquetting of every grade and quality of coal. They also claim that the briquets manufactured by them in Seattle withstand the moist climate of the Northwest without disintegration, and hold up perfectly in the fire until entirely consumed under the severest forced draft boiler tests.

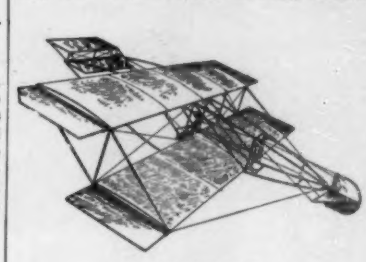
Household Utilities.

RECEPTACLE FOR GARBAGE AND WASTE PAPER.—I. HOFFMAN, 86 Lenox Avenue, New York, N. Y. The object of Mr. Hoffman's invention is to provide a receptacle for separately receiving and storing garbage and waste paper, and arranged to permit of conveniently carrying the receptacle about and emptying the same of its contents separately. For the purpose mentioned, use is made of a receptacle having separate upper and lower compartments, of which the upper compartment is for the reception of garbage and the lower for waste paper, the upper compartment having a hinged lid and the lower having side openings for the introduction of waste paper, and a hinged bottom for opening and closing the lower compartment. The engraving pictures a perspective view of the receptacle with the cover and bottom in open positions.

RECEPTACLE FOR GARBAGE AND WASTE PAPER.

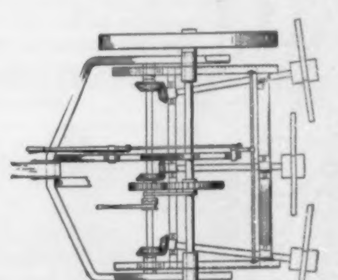
Machines and Mechanical Devices.

FLYING MACHINE.—OTTO A. FENN, 1976 Hughes Avenue, Bronx, New York. This machine is of the heavier-than-air, or aeroplane type, and a perspective view of it is presented in the illustration herewith. The objects of the inventor are: To provide a flying machine with a plurality of supporting planes, offset from one another out of vertical alignment; to provide means for directing the vertical travel of the machine, and with a universal rudder for further controlling the direction of travel of the machine; to provide a machine with supporting planes capable of being distorted into parachute form, so as to effect a safe landing in case of accident to the motor or other parts of the machine; and to provide a device, simple in construction, light in weight, inexpensive to manufacture, strong, durable, and reliable and positive in operation.



FLYING MACHINE.

THINNING MACHINE.—S. STONE, Miles City, Mont. In this patent the invention relates to improvements in machines for thinning or cutting out the superfluous plants of such character as are "drilled" and planted in rows, and has for its object to provide a machine for expeditiously and efficiently thinning and cutting such plants, it being intended more particularly for onions, beets and plants that are allowed to grow to maturity at short intervals to one another, but may be used for cotton plants. The machine has great adaptability and will operate on three rows at a time. In the engraving inserted herewith is pictured a top plan view of the device.

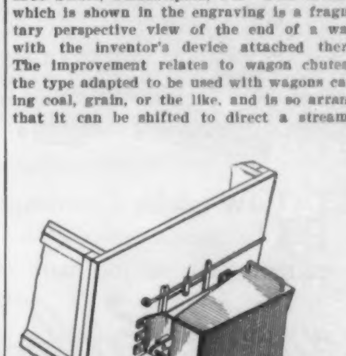


THINNING MACHINE FOR PLANTS.

Prime Movers and Their Accessories.

ROTARY PUMP, ROTARY ENGINE, AND THE LIKE.—W. A. BEARD, London, England. The main object of this invention is to provide a pump which, for its weight and simplicity in construction, is adapted to pass a comparatively large quantity of fluid. A further object is to provide a simple form of pump in which the leakage between the outlet and inlet sides is minimized and does not increase when the parts of the pump are worn.

WAGON CHUTE.—JOHN G. SMITH, 525 N. 35th Street, Philadelphia, Pa. This invention which is shown in the engraving is a fragmentary perspective view of the end of a wagon with the inventor's device attached thereto. The improvement relates to wagon chutes of the type adapted to be used with wagons carrying coal, grain, or the like, and is so arranged that it can be shifted to direct a stream of the material from the wagon to either side thereof. An object is to provide a movable chute capable of being reversed, so as to direct a stream of material to either side, with means for supporting an auxiliary chute, and with means for locking it in any adjusted position. The device is simple in construction, inexpensive to manufacture, readily accessible, strong, durable, and easily adjusted.



WAGON CHUTE.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12613) P. C. T. asks: Why, after a severe and prolonged cold spell, when the temperature commences to rise, do we experience more trouble with the freezing of water pipes? The greater trouble is experienced when the temperature changes; the frost continues to go down, and apparently more rapidly than before. A. The question you ask is as you say a matter of popular belief, and probably like most popular beliefs has some foundation in fact, if one can find out what that is. We are inclined to think that freezing goes on below the ground after the temperature has begun to rise in the air above because the ground has been cooled considerably below the freezing point of water during the cold spell. The air is a non-conductor of heat, and so the earth below does not receive heat from the air very rapidly. The freezing is finally stopped by the heat from the earth lower down raising the temperature of the frozen layer above to the freezing point, thus arresting the formation of ice at the lower edge of the frozen layer. We doubt whether the impression is correct that the freezing below proceeds *more rapidly* after the air above begins to become warmer. It does not seem reasonable, and we do not see how it can be proved. Certainly one cannot dig down to find out about the matter, for upon digging down the lower layer becomes the surface layer, and proof is lost. That water pipes freeze after the air becomes warmer only proves that the frost had not reached the depth of the pipes till the severe cold in the air was over.

(12614) J. L. B. asks: Will you kindly inform me why cold weather is less unpleasant if the air is dry? Can it be due to a difference in specific heat between moist and dry air? Or is it because we wear woolen clothing, which might become a better conductor of heat by absorbing moisture in damp air? These explanations seem to me hardly adequate. A. As your inquiry indicates, it is not so easy to give the reason why cold, damp air on our eastern seaboard feels so much colder than still colder dry air in the interior of the country. It is also true that damp air here on the coast feels colder than dry air of the same temperature. Probably both the reasons you suggest are involved in the explanation of the question. The specific heat of water vapor is about twice that of dry air, and hence damp air will cool the body more than dry air for the same change of temperature in the air in contact with the body. It is also true that the water vapor in the air and in our clothing renders it a better conductor of heat, and enables the air to cool us more rapidly. On this point we quote Davis' "Meteorology" (price $2.75 postpaid): "The humidity of the atmosphere exercises a strong control over our bodily sensation of the temperature of the air. The body does not act like a thermometer, readily accepting the temperature of the surrounding medium, but attempts to maintain an internal temperature of about 98 degrees, known as 'blood heat,' at all seasons. We prevent an uncomfortable reduction of temperature in cold air by sheltering the body by a covering of clothing; if the air is windy, more protection is needed than when it is calm; if it is damp as well as cold and windy, it abstracts all the more heat from us, probably by means of the better conductivity given both to the air and the clothing by the moisture; hence the difference between the bracing though severe cold of our dry northwest winter winds and the penetrating, searching chill of our damp winter northeasters. The difference between the so-called 'dry cold' of the interior and the 'damp cold' of the New England coast is thus explained."

(12615) W. W. J. asks: Will you be so kind as to advise on the following query, or tell me of some book from which the information may be secured? What chemicals are necessary for generating hydrogen gas, and what proportions? Chemicals to be placed in an air-tight cylinder and heated to generate. A. There are several modes of preparing hydrogen by heating chemicals in a retort. Sodium hydroxide and iron powder; calcium hydroxide and zinc or iron powder; aluminium and sodium hydroxide solution are used in this way. The details for the safe performance of the experiments are to be found in Benedict's "Chemical Lecture Experiments," price $2, a book which all ought to have who are engaging in such experiments.

(12616) J. B. C. asks how to make a polishing cloth. A. Saturated woolen stuff with a solution composed of 3 oz. 4 dr. of Castile soap dissolved in 14 oz. of water; to this solution add 22 dr. of tripoli. Color with caroline if it is desired.

LEGAL NOTICES

Classified Advertisements

FOREIGN PATENT APPLICATION

Application for a patent for

"Improvements in Method for Desiccating Milk"

Be it hereby made known for general information that HARRY IRVING ANDREWS, of Darien, in the County of Fairfield, State of Connecticut, U.S.A., Manager, on the 6th day of January, 1912, deposited at the office of the Attorney General Bloemfontein, an application for a Patent right for the above-mentioned invention, with accompanying description.

Whereas now the said HARRY IRVING ANDREWS has given me written notice that he desires to proceed with his application, I have decided that this application, and all objections thereto, will be dealt with at my office at Pretoria on the 10th day of May, 1912, at ten o'clock in the forenoon.

I therefore call upon all persons who are interested in opposing the issuing of Letters Patent for the above-mentioned invention, to file at my office, or at the office of the Attorney General Bloemfontein, before the day of hearing the same, a document explaining their objections, as they will otherwise be excluded from bringing them forward.

Given under my hand at Pretoria, South Africa, this 13th day of January, 1912.

(Signed) C. W. DE VISPERS,
DEPUTY OF THE MINISTER OF JUSTICE.

PROPOSALS

CONTRACTORS

Subway Bids Opened March 22, 1912

for the construction of Section 2-A of the Lexington Avenue Rapid Transit Railroad of New York City. 530 feet of four track subway, between Walker Street and a point 50 feet north of the center line of Howard Street, embracing the Canal Street station and the underlying portion of the Canal Street subway.

Write or call concerning forms of contracts, plans and specifications.

PUBLIC SERVICE COMMISSION
***for the* FIRST DISTRICT**

154 Nassau Street New York City

NEW BOOKS, ETC.

THE SPELL OF HOLLAND. The Story of a Pilgrimage to the Land of Dykes and Windmills. By Burton E. Stevenson. Boston: L. C. Page & Co., 1911. 8vo.; 395 pp. Illustrated. Price, $2.50.

At the gateway of "Hollowland" the customs officer, scorning to be bound by the conventional "Tobacco or spirits?" asks if you have any candy or cakes to declare. This is an indication of the deliciously quaint habits and modes of thought that obtain in this quaint and delicious country. Mr. Stevenson's narrative is alive with humor. Every page has a twinkle in it, and some have two or three. On finishing the book one hardly realizes the amount of worthwhile knowledge one has acquired, for it has been gained with such smiling ease. The frontispiece shows a typical bit of Netherlands scenery with its vari-colored walls and sleepy waters. A folding map traces the author's route, and fifty full-page plates are the product of his busy camera, to which, in spite of its finder pointing too low, the reader owes a debt of gratitude.

WHERE THE SHAMROCK GROWS. By George H. Jessop. New York: The Baker & Taylor Company, 1911. 12mo.; 224 pp. Price, $1 net.

This is not a work on the Irish flora, as might be inferred from its title and from its inclusion among reviews of scientific publications, but a simple story of an Irishman's return from America to the land of his birth. It makes light but thoroughly wholesome reading, and its comedy-drama of hot heads and warm hearts is well charactered and distinctly entertaining.

A POCKET MEDICAL DICTIONARY. By George M. Gould, A.M., M.D. Philadelphia: P. Blakiston's Son & Co., 1911. Price, $1 net.

This is a sixth edition of one of Dr. Gould's handy little compilations, and gives the pronunciation and definition of 34,000 terms used in medicine, physiology, and allied branches of science. There are tables of bacilli, of bacteria, of bones, of chemic elements, of micrococci, of the muscles and nerves, of spirilla, of weights and measures. Dose tables for physicians and veterinarians bring to a conclusion the very useful compendium.

ELEVENTH ANNUAL MEETING OF THE NATIONAL CIVIC FEDERATION. New York, January 12th, 13th, and 14th, 1911. Welfare Workers' Conference. New York: The National Civic Federation, 1911.

This report gives the full text of the papers read, and sets forth the progress made during the previous year and the plans for the future. Among other laudable activities in which the Federation, under its president, Seth Low, is engaged, may be mentioned the promotion of uniform State laws upon matters of common interest; an educational campaign directed toward employers, with a view to bettering the condition of the employed; and a consideration of the problem of compensation for industrial accidents. There are noteworthy papers on the trusts and the wage earners, by such authorities as Samuel Untermyer and Samuel Gompers, and a discussion on "Justice, Common Sense, and the Pay Roll," by Harrington Emerson.

RUGS OF THE ORIENT. By C. R. Clifford. New York: Clifford & Lawton, 1911. Folio, 109 pp.; illustrated. Price, $3.

The many people who take delight in Eastern rugs will welcome this folio, which is compliant and informing both to artistic and commercial demands. Seven rules of identification are given, covering design, coloring and technique, so that the purchaser who masters them may feel reasonably sure of the section from which the rug comes. There is a chronological history of the Orient, which furnishes a key to the overlapping of tribes and tribal characteristics as manifested in handicraft. A vocabulary of terms includes the rug districts and the nomenclature of manufacture. The characteristics of weaves are reduced to a table, which greatly facilitates identification. The use of rugs according to periods of history is another enlightening section. The most striking feature of such a folio as this should be, and is, the reproductions of various types of rugs. There are large plates of mellow tone and great beauty, interspersed with lesser illustrations and much clear descriptive matter. There are no reproductions in color, but aside from this the work is all that could be expected, and exhibits the greatest care in arrangement, accuracy in information, and taste in selection.

MODERN SCIENCE READER. With Special Reference to Chemistry. Edited by Robert Montgomery Bird, Ph.D. New York: The Macmillan Company, 1911. 8vo.; 323 pp.; illustrated. Price, $1.25 net.

The "Modern Science Reader" is a reprint of twenty-seven papers which have appeared in the leading journals of the day. Each is a studied, well-written account of some object or phase of modern science, often with a very practical application. The papers begin with "The Romance of the Diamond," by Sir William Crookes, as originally published in the *North American Review*. This is followed by such subjects as "Making Money Out of Waste," "Modern Explosives," and "The Creators of the Age of Steel." Biological and

physiological subjects are introduced through "The Yeast Cell and Its Lessons," and "The Chemical Regulation of the Processes of the Body." There is a compend of "The Science of Chemistry," and then follows a series of fascinating essays dealing with the theories and achievements of the new science as contrasted with the outgrown or metamorphosed beliefs of earlier ages. While each subject is presented with a masterly simplicity and charm that must lead us to catalogue the volume in the "popular" class, there is no meretricious or distorted work such as is usually considered necessary in appealing to readers at large. The compilation seems to furnish one of those rare cases where both advanced student and general reader may meet on common ground and enjoy together the vistas unfolded to the view.

The Theory and Practice of Technical Writing. By Samuel Chandler Earle. New York: The Macmillan Company, 1911. 8vo.; 301 pp. Illustrated. Price, $1.25 net.

The engineer or scientist who has a lecture to prepare, a paper to write, or an experience to make public—and how many of the fraternity escape these honors entirely?—often comes to his task with a deep knowledge of his subject, but with only the haziest idea of the proper way to shape it into acceptable form. The author makes plain the differences between descriptive, narrative, expositive, directive, and critical writing, and the very determination of the nature and scope of a projected article often clarifies the mind and results in a more concise and forceful style. From the principles of logical structure we proceed to the practical application of these principles. This division includes instructions for addressing the general reader, addressing the specialist, on the final form of the article, and on methods of writing. An appendix constituting a third of the volume is devoted to concrete examples of good technical writing, with all the necessary plates and diagrams to which the papers refer. Several recent publications have aimed to cover the same field, but this is the most thorough and helpful work that has yet come under our notice.

The Art of the Vienna Galleries. By David C. Preyer, A.M. Boston: L. C. Page & Co., 1911. 12mo.; 331 pp. Illustrated. Price, $2 net.

In the galleries of Vienna are some six thousand canvases, many of them of the first importance and value. Titian, Palma, Giorgione, Tintoretto, and Rubens are all well represented, and numerous paintings which bear less familiar names have been acclaimed as almost equal in rank and merit with those of the accepted masters. In short, so rich is Vienna in art collections, that high authority places her above all other cities save London, Rome, Paris, and St. Petersburg. The duogravures of the volume commendably reproduce, or at least suggest, the handling of light and shade and the general treatment of the originals. In Bonovicino's "St. Justina"—a picture much praised, which has even been made the foundation of a German novel—we get the atmospheric delicacy, the crystal illumination, for which the artist is justly famous. Van Dyck's "Prince Rhodokanakis" shows a well-lighted portrait; we instinctively acknowledge the charm of the intellectual forehead, the sane and kindly side-glance of the eyes, and the strong, white hand resting upon the sword-hilt. Rubens is represented by "The Pelise," and Rembrandt by the portrait of his mother. Ruisdael's "Great Forest" is a landscape worthy of mention, while in "The Glutton" we find a good example of Jordaens' almost brutal fidelity to the coarser phases of life. Mr. Preyer's descriptive writing is vivid, vigorous, and satisfying. His comparisons are drawn with a sure touch, and the volume as a whole cannot fail to make enthusiastic friends.

The Design and Construction of Mill Buildings. By Henry Grattan Tyrrell, C.E. Chicago and New York: The Myron C. Clark Publishing Company, 1911. 8vo.; 490 pp.; illustrated. Price, $4 net.

Mr. Tyrrell has given us, out of his twenty years' experience, a volume of the most helpful and practical information on the location, planning, design, and building of the modern industrial plant. A brief consideration of the amount of capital invested in the mills and shops of the country, and of the close relation of site and design to output and profits, will demonstrate the importance of the subject. It is of vital moment that an accurate knowledge of requirements and possibilities precede the design; only thus can satisfactory results be obtained. The volume in hand omits matter readily available in other standard textbooks to make room for those points of principle and construction which have been generally neglected in the literature of the subject. Ground floors, being of the most importance, are studied most carefully and illustrated in detail. A great amount of reference material, much of it taken directly from the writer's private notes and records, is included—such tabulated helps, for example, as check lists for estimates and contracts, the day-wages in the various building trades for the chief centers of the country in 1910, shop costs, freight rates on structural steel, approximate estimating prices, and the required wall-thicknesses according to the building laws of different cities. The faculties of clear reasoning and ready expression are in evidence throughout the work.

Wentworth's Plane and Solid Geometry. Revised by George Wentworth and David Eugene Smith. New York: Ginn & Co., 1911. 12mo.; 470 pp.; illustrated. Price, $1.30.

The popularity of the old Wentworth Geometry as a school text-book is indisputable, and is due to its unquestionable merit. A comparison of this revised edition with the earlier editions shows a marked advance in many ways. The simplicity of treatment has been not only maintained, but even improved upon; the number of propositions has been decreased so that only the great basal theorems and problems are now included in the body of the work, while less important material is relegated to an appendix, to be used or not as circumstances may require; the exercises have been subjected to a systematic grouping, and are so numerous that selections from them may be made from year to year; reasons are plainly stated, the practical application of principles is indicated wherever advisable, and the relations between algebra and geometry are clearly established. The work may also be obtained in two volumes, the one devoted to plane, the other to solid geometry. It is hardly necessary for us to add our endorsement to those which, over the signatures of our best-known instructors, congratulate the compilers upon having improved upon a text already accepted as almost perfect.

Luftfahrzeugbau Konstruktion Luftschiffen und Flugmaschinen. Von Dr. Fritz Huth. Berlin W.; M. Krayn, 1910. 335 pp.

This is the second edition of a book which has deservedly met with much success in Germany. The author tells us that in this second edition he has endeavored to bring his work up to date. In this he has not been altogether successful, for we note that the old Wright construction is described in more or less detail, and that in his discussion of the elevation rudder, the author ignores the fact that in the new Wright biplane the elevator has been transferred to the rear of the machine, where it acts as a tail as well as guiding surface. Moreover, the change was made in this and other machines for the very reasons that he brands as untenable. Apart from the fact that the constructions discussed are not altogether new (and, after all, the changes made in monoplanes and biplanes since the days when the Wright brothers made their epoch-making experiments and Blériot flew across the Channel have not been markedly radical), the book can be safely commended as a clear, authoritative statement of the principles underlying the design of airships and aeroplanes, with just enough mathematics to enable a builder to proceed with the intelligent construction of an air craft.

Speed and Consumption of Steamships. With Algebraic Formulæ for Economical Speed. By J. F. Ruthven. London: J. D. Potter, 1911. 8vo.; 78 pp.; diagrams.

This is a second edition of a work first issued in 1906. The writer's experience has been acquired chiefly in vessels of the British Mercantile Marine, and the rules that are therein amplified are founded on the formulæ of the Admiralty co-efficient. By the "cube of the speed and two-thirds power of the displacement" rule, it is possible to find, at least at fair speeds up to 15 knots, a constant for the engine consumption, from the actual coal burnt at the regular working speed, without knowing the indicated horse-power. From the approximations arrived at by this rule, the daily consumption total may be readily tabulated, and a table of miles per ton at each speed made out. An added chapter on stability defines such terms as the center of buoyancy, transverse and longitudinal meta-centers, and the moment of inertia, elucidates the action of combined forces upon a hull, and presents rules and formulæ for the practical application of the theory.

Fighting Ships. By Fred T. Jane. Special Chapter on the Progress of Marine Engineering by Charles De Graves Sells, M.I.C.E. Containing 543 pages and several thousand illustrations. London: Sampson Low, Marston & Co., Ltd., 1911. (Fourteenth year of issue.) Price, $8.50.

Jane's "Fighting Ships" needs no introduction to that ever-increasing class of people who follow closely the growth of the world's navies. Jane in his work gives a photograph, plan, and side elevation of every warship of any importance in each navy of the world. Also of each ship he gives the dimensions, guns, armor, motive power, etc. Special features this year are the frontispiece, showing some fine views of the firing done on the old U. S. battleship "Texas." The Italian navy section contains hitherto unpublished data of the four new Italian dreadnoughts. Old photographs of ships have been replaced by others specially taken during last year, and this is particularly true of the German and United States navies. Among these photographs are the latest British, United States, Japanese, French, and other battleships, destroyers, and cruisers. A new feature is the grouping together of all dreadnoughts, whether of the battleship or armored cruiser type. Considerable additions have been made to the pages devoted to auxiliaries and miscellaneous vessels. The section of this work devoted to the United States navy is very complete, thanks to the careful labors of the American correspondent, H. Reuterdahl.

Our Latest Battleships

(*Concluded from page 218.*)

power of the side armor. Associated with the heavy belt in the work of protecting the ship's stability are two protective decks—a lower deck 1½ inches thick on the flat which will slope along the sides to a junction with the bottom of the armor plate 8½ feet below the water line. The slopes of this deck are 2 inches in thickness. On the deck above (the gun deck) is an upper protective deck, 3 inches in thickness. These two decks provide an excellent protection against plunging fire, and also against fragments of shells which might be exploded in passing through the thin ship's plating in the wake of the gun deck.

Equally massive is the armor protection for the main gun positions. The barbette armor extends, with a thickness of 13 inches, from the turret down to the upper protective deck, and from the upper to the lower protective deck the thickness is reduced to 4½ inches—this because of the 13-inch protection afforded by the side armor. The turret armor is equally massive. The port plate is 16 inches on the two-gun turrets and 18 inches on the three-gun turrets, and the side and rear armor is 10 and 9 inches in thickness, while the roof carries 5 inches of armor.

The battle of the Sea of Japan showed how important it is to thoroughly protect the positions from which the fighting of the ship is controlled, and particular attention has been given to this in our new design. The conning tower and the signal station back of it each carry no less than 16 inches of armor, and to protect the communications—telegraph and telephone wires, voice tubes, etc.—the section upon which conning tower and signal station are supported has walls of 16-inch armor, which are carried down to the protective decks.

It will be noticed that the new ships have but one smokestack—and thereby hangs a tale. The new ships, as already stated, will burn fuel oil exclusively. This has enabled the designer to dispense entirely with coal bunkers—the oil being carried chiefly in the double bottom of the ship. The omission of bunkers sets free a large amount of space below decks, which has enabled the designer to concentrate all of the six boiler compartments at the center of the ship, where they occupy only 85 feet of her length. Hence, it was possible to use a single smokestack, placed immediately above the boiler rooms, and hence, again—and this is the important point—it was found possible to place around the whole of the uptakes a massive redoubt of inclined armor with walls everywhere 13 inches in thickness. This redoubt extends from the upper protective deck to the spar deck, and that portion of the smokestack and uptakes which is within the structure of the ship will be completely protected against perforation. The importance of this construction will be appreciated, when we bear in mind that, in the Japanese war, it was the perforation of the uptakes which contributed largely to the collapse of the Russian ships. The poisonous gases, escaping between decks, were drawn down and disseminated throughout the ship, frequently driving the crew from their quarters.

From the above description it will be evident that in the "Nevada" and "Oklahoma" the United States navy will possess two fighting ships which will be the equal, if not superior, to any ships in their gun power and which will be greatly superior in their power of endurance in a long-drawn-out fight. If Congress will only be wise enough to add year by year the two battleships which represent the minimum requirement of our navy, we shall be in a position to maintain our standing among the navies of the world. If less than two battleships a year be authorized, our navy will steadily retrograde.

The Turret Telescope

(*Concluded from page 218.*)

made to the optical arrangements. The mechanical parts have a precision seemingly quite as great as the ordinary equatorial mounting. On the other hand this new mounting is in many respects decidedly superior to the standard form.

Disregarding for the time being the temperature of the observing room, the observer with the turret telescope should measure more quickly and more accurately with a micrometer, for the observer would always be in a comfortable position, and no time would be wasted in ad-

justing the height of the observing chair, a star near the zenith being as easily observed as one near the horizon. For photographic or spectrographic work the new form of telescope should be also superior, for the eye-piece being firmly held in the turret, it would not be necessary to alter the counterweights when camera or spectrograph are substituted instead of micrometer. The added advantage of a comfortable room would seem to make this new telescope of Mr. Hartness the ideal mounting.

In fact, the only objection that seems possible to make against it is that it is an open-air telescope, and that it would vibrate badly from the winds. The ordinary telescope is sheltered by the dome except when the wind blows through the slit, and then by the use of wind screens, as at the Yerkes Observatory, the force of the wind may be minimized. It must be remembered, however, that the turret telescope is rigidly fixed at the eye end, and braced at the objective. Mr. Hartness was appealed to by the writer regarding this point, and has stated that the wind has little effect, that a rigid test of the instrument will be given, and then, if necessary, it will be easily possible to shelter the tube entirely from the wind.

The cost of this new form of telescope would be greater than that of the ordinary equatorial mounting. But no dome with running gear is necessary for it, so that the cost of building observatory and telescope together would not differ much in the two cases. If a demand were created for turret telescopes, their cost would gradually decrease.

Taken altogether, the invention of the turret telescope by Mr. Hartness is one of the biggest improvements in mountings that has taken place for a long time.

Confusion of Names of Commercial Woods

No branch of forestry requires the investigation of men of science more than the history and structural character of the commercial timber trees. It is lamentable to see so many talented men devote their entire lives to the study of small groups of relatively unimportant plants of the desert or the ocean, while we are still ignorant even of the botanical names of a good many trees yielding timber of commerce. A number of the trees of West Africa, which produce a large percentage of the choicest timber used in England and in the United States for furniture and high-grade cabinet work, are now known in the trade by no other name except mahogany, when in reality they do not belong to the mahogany family at all. Coccobola from Central America has been imported into this country for over a hundred years, but to-day no one seems to know what tree yields this wood. A number of examples of this kind could be cited in regard to important timbers which come from the tropics.

This lack of knowledge is the chief reason why so many different woods which bear the slightest resemblance have been given the same common or trade name. Such a duplication of vernacular names has produced among the woods of commerce a confusion and brought about a mass of errors that it appears almost hopeless to expect to unravel them. For instance, there are now more than fifty different woods sold under the comprehensive trade name mahogany; there are more than twenty-five referred to under the name cedar; there are more than a dozen rosewoods; equally as many satin woods, iron woods, and box woods, not to mention a number of beef woods, ebony woods, sandal woods, teak woods, gum woods, walnuts, and a host of others, named according to the fancy of the shippers and importers. The duplication of names has become so complicated that dealers are now unable to know what kind of mahogany, cedar, walnut, or gum to supply when their customers order woods by these names.

Timber constitutes a very important product of the foreign commerce of this country. To many the number of different kinds of woods imported will be a matter of great surprise, but numerous as they are now they are few compared with those which will be introduced into the American markets when the forest resources of Africa and South America become more generally available. Not a month passes but what some importer adds another mahogany, cedar, or rosewood to the long list of substitutes. Public attention and the investigation of

scientific men are being gradually directed to this branch of work, and it is hoped that something can be accomplished which will prove helpful in protecting the purchasers from getting the spurious kinds when genuine sandal wood, rosewood, or mahogany is specified.

One of the "Ten Stories"

[*Many of our readers have doubtless heard of the "Ten Stories," a little book containing true narratives of scientific events in which the* Scientific American *played a predominant part. It has been quite impossible to meet the demand for the "Ten Stories." Accordingly, they will be republished, one at a time, in these columns, for the benefit of those readers who were unable to obtain a copy of the original booklet.*—Editor.]

The Forty-pound Horse Collar

A BIG, powerful man came into the office of the Scientific American one day carrying a full-sized iron horse collar.

"I am a blacksmith from Canada," he said. "I hammered this out on the anvil. It is going to be used instead of ordinary leather collars."

It weighed forty pounds.

"How is a horse to carry this load around his neck and draw a heavy load as well?" he was asked.

"This is a little heavier than it need be," he explained. "It will be all right."

An effort was made to dissuade him from wasting money on a horse collar that weighed forty pounds, but he was sure of his ground.

Six months later the Canadian returned with another collar, an improvement on the original and which weighed but fifteen pounds.

Three times the man came back. Each time he brought with him a new metal collar, lighter and better than its predecessor.

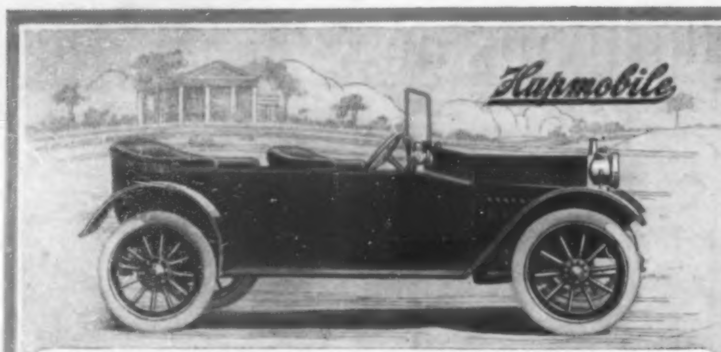
Now almost every fire-engine horse and omnibus horse in this country and in Europe wears what is known as the stamped-up metal collar. From forty pounds the Canadian had reduced its weight to almost as many ounces. He has given up blacksmithing and lives in great luxury in London.

The Current Supplement

NUMBER 1888 of the Scientific American Supplement, the companion of this issue, brings an account of Herman Frasch's distinguished career. Every reader who takes a patriotic interest in the achievements of American applied science should make it a point to study this remarkable biographical sketch of the man who revolutionized the sulphur industry, and who has just been honored by the award of the Perkin medal.—C. F. Elwell contributes an important article on electric induction furnaces, discussing them from the point of view both of the electrical engineer and of the metallurgist, and presenting a summary of costs.—A ferry steamer built for service on the Russian river Volga, and presenting a number of remarkable and interesting features, is described. Some idea of the difficulties presented in the design of this ferry may be gathered from the fact that a possible difference of no less than 45 feet in the water level has to be reckoned with.—Prof. John A. Switzer writes on "Economic Aspects of the Smoke Nuisance."—Dr. A. F. Zahm contributes a very able analytical review of a memoir on "The Resistance of the Air and Aviation," the author of which is the great French engineer, Eiffel, the same who built the tower that bears his name.—A very good summary of the state of the art of color photography is reproduced from a German source.—Dr. H. W. Hill is making a campaign to spread abroad a full understanding of the modern principles of disease prevention. His article in this issue is entitled "Shall Contagious Diseases be Abolished?"—The rules governing the competition for the Gould prize appear on the last page of this number.

The $15,000 Gould Prize

THE current issue of the Scientific American Supplement contains a copy of the rules governing the competition for the $15,000 prize offered by Mr. Edwin Gould for a heavier-than-air flying machine, the competition taking place under the auspices of the Scientific American.



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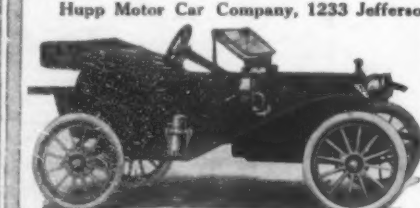

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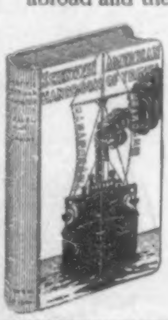

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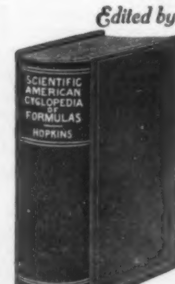

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